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LACV-30 TEST AND DEMONSTRATION REPORT.(U)

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LACV-30 TEST AND DEMONSTRATION REPORT


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This report presents the test data and analysis of all acceptance and type tests performed on the LACV-30-1 and -2 vehicles. The tests were performed as specified in Contract No. DAAK02-75-C-0149 dated 7 March 1975.

All test data were accepted by the U.S. Army prior to delivery of the vehicles. Two corrective actions were required on the LACV-30-1, installation of a new horn and addition of bow pre-loaders to maintain pressure on the front landing pads during swing crane operation.

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## ABSTRACT


This report presents the test data and analysis of all acceptance and type tests performed on the LACV-30-1 and LACV-30-2 vehicles. The tests were performed as specified in Contract No. DAAK02-75-C-0149 dated 7 March 1975.

All test data were accepted by the U. S. Army prior to delivery of the vehicles. Two corrective actions were required on the LACV-30-1, installation of a new horn and addition of bow pre-loaders to maintain pressure on the front landing pads during swing crane operation.

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1.0 INTRODUCTION

1.1 GENERAL

This Test and Demonstration Report for the LACV-30 Air Cushion Vehicle fulfills the requirement of Contract No. DAAK02-75-C-0149. This report includes all the acceptance and type tests performed on the LACV-30-1 and LACV-30-2 vehicles as part of the vehicle demonstration program and proof of design tests.

Where possible, vehicle performance estimates are presented for comparison to measured test data. Contractor's tests performed but not specified in the contract are presented in the Appendices.

1.2 GENERAL VEHICLE DESCRIPTION

1.2.1 GENERAL

The Bell Model 7467 LACV-30 (Lighter, Amphibian Air Cushion Vehicle-30-Ton Payload) is a fully amphibious, high speed craft planned to meet projected Army needs as identified in the Required Operational Capability Document (ROC). It is a high mobility vehicle capable of transporting military cargo payloads in the 25 to 30 short ton category (including MILVANS) primarily in support of the logistics over-the-shore (LOTS) mission involving operations over water, marginal areas and land.

The LACV-30 is a hardened version of the standard commercial Bell "Voyageur" Model 7380 ACV which is in production and already operating in a number of remote area cargo haul applications.

To provide the U. S. Army with an optimum craft, the following hardening items are included in the LACV-30:

| Hardening Item | Provides |
|---|---|
| 1. Longitudinal Stretch | Increased payload weight and deck area capability |
| 2. Air Management System | Longer engine life (intake air filtration to remove sand/water). Improved quality air to cabin. More lift fan output for cushion air. APU power take-off availability provides 15 VAC. High intake stack minimizes water ingestion in the surf zone. |

| Hardening Item | | Provides |
|---|---|---|
| 3. | Load-Spreader Pallets | Loading of U. S. Army-specified tracked and wheeled vehicles and containers. |
| 4. | Surf Fence | Improved surf transition. |
| 5. | Uprated Engines | Increased payload and/or craft performance. |
| 6. | Improved Propeller Blades | Increased payload and/or craft performance. |
| 7. | Communications/ Navigation System | Compatibility with U. S. Army requirements. Night and low visibility operations. |
| 8. | Cabin Soundproofing | Improved habitability for intensive operations. |
| 9. | Cargo Securing System | Fast, effective cargo tie-down System |
| 10. | Anchor System | Craft anchoring |
| 11. | Cabin Air Conditioning | Heating and cooling for improved habitability |
| 12. | Deck Winch | Cargo handling. Craft self-retrieval and improved gradeability. |
| 13. | Auxiliary Equipment | To Army requirements |
| 14. | Craft Marking | To Army requirements |
| 15. | Bow Ramp System (Ground Support Equipment) | Roll-on/roll-off of specified tracked and wheeled Army vehicles and MHE |
| 16. | Craft Fendering (Ground Support Equipment) | Improved craft skirt protection during operations alongside container ships |
| 17 | Swing Crane | Self-unloading capability |

1.2.2 VEHICLE CHARACTERISTICS

A 3-view of the Model 7467 LACV-30 is provided in Figure 1.1. The following subsections give leading particulars of the vehicle.

1.2.2.1 PRINCIPAL DIMENSIONS

| | |
|---|---|
| Overall length (without optional swing crane) | 76 ft 3 in |
| Overall beam (skirts inflated) | 36 ft 8 in |
| Overall height on landing pads | 21 ft 6 in |
| Overall height from skirt hemlines (hovering) | 24 ft 8 in |
| Cargo deck length | 51 ft 6 in |
| Cargo deck width | 32 ft 6 in |
| Cargo deck height | 3 ft 11.5 in |
| Cushion Height | 4 ft 0 in |
| Cushion area | 2061 sq ft |
| Cushion pressure at gross weight 1g | 55.8 psf |
| Reserve buoyancy | 155% |

1.2.2.2 POWER AND TRANSMISSION

| | |
|---|---|
| Engines | 2 UACL/Pratt & Whitney Twin Pac ST6T-76 gas turbines |
| Maximum rating (std day) (each) | 1850 SHP |
| Normal rating (std day) (each) | 1400 SHP |
| Propellers | Two Hamilton Standard 3-blade variable pitch (HSD Model 43D50-363) |
| Lift Fan | Two Bell/British Hovercraft Corp., 7 ft. centrifugal, 12-bladed, fixed pitch |

1.2.2.3 FUEL

| | |
|---|---|
| Fuel Types | Standard turbine fuel either Jet A-1, JP-4, JP-5, or light diesel fuel oil |
| Main fuel usable capacity | 1,272 U.S. Gal. (15,450 lb) |
| Fuel Ballast Emergency fuel capacity | 294 U.S. Gal. (5,400 lb) |

1.2.2.4 ELECTRICAL

Starter Generators per Twin Pac

| | |
|---|---|
| Powerplant | Two (4 total) Gearbox driven b rushless 28 VDC, 200 amps (each) |
| Batteries | Two nickel-cadmium 28 VDC, 40 amp hr (each) |
| Generator (APU) | One gearbox driven 115 VAC, 400 H. |

1.2.3 INSTRUMENTATION SYSTEM

The U. S. Army follow-on Development Test Program for LACV-30-2 employed an analog instrumentation system capable of recording 76 multiplexed channels of data on magnetic tape. The data were capable of being time-coded, voice-annotated, and event-marked.

The major portion of this data acquisition system is pallet mounted and installed on the fore deck just below the cabin. The pallet contains the tape recorder, multiplexes, signal conditioners, amplifiers, converters, patch panel, time code generator, power distribution panel, and attitude/rate gyros. The system controls and displays (time, oscillograph, and visual meters) are located in the cabin and manned by the navigator. Primary power (28 vdc and 115v 400H AC) is supplied from the craft electrical system to the pallet and distributed. Table 1.1 is a listing of parameters with range and type of sensor to be used.

Data were gathered in land and water tests as required by specific development test objectives. All parameters are recorded. The patch panel is utilized to provide the test engineer with selected

information pertinent to a particular test. These data can be "quick look" reviewed to verify attaining test conditions and to determine trend information.

The test engineer is provided with an "Event Mark" control to identify a specific data point on all recorded information. Additionally, the test engineer maintains a detailed log in time code of all tests and significant occurrences.

The Instrumentation System was installed by BAT and its operation verified during the Contractor Test Program.

TABLE 1.1. INSTRUMENTATION PACKAGE ON LACV-30-2

| | PARAMETER | RANGE | SENSOR | ERROR |
|---|---|---|---|---|
| 1. | Power Turbine Temperature | 0-1300°F | Engine Pickup | ±10° |
| 2. | Power Turbine Temperature | 0-1300°F | Engine Pickup | ±10° |
| 3. | Power Turbine Temperature | 0-1300°F | Engine Pickup | ±10° |
| 4. | Power Turbine Temperature | 0-1300°F | Engine Pickup | ±10° |
| 5. | Gas Generator RPM | 0-105% | Engine Pickup | ±.5% |
| 6. | Gas Generator RPM | 0-105% | Engine Pickup | ±.5% |
| 7. | Gas Generator RPM | 0-105% | Engine Pickup | ±.5% |
| 8. | Gas Generator RPM | 0-105% | Engine Pickup | ±.5% |
| 9. | Power Turbine RPM | 0-100% | Engine Pickup | ±.5% |
| 10. | Power Turbine RPM | 0-100% | Engine Pickup | ±.5% |
| 11. | Power Turbine RPM | 0-100% | Engine Pickup | ±.5% |
| 12. | Power Turbine RPM | 0-100% | Engine Pickup | ±.5% |
| 13. | Engine Torque | 0-70 psi | Engine Pickup | ±1.0 psi |
| 14. | Engine Torque | 0-70 psi | Engine Pickup | ±1.0 psi |
| 15. | Engine Torque | 0-70 psi | Engine Pickup | ±1.0 psi |
| 16. | Engine Torque | 0-70 psi | Engine Pickup | ±1.0 psi |
| 17. | Air Intake Temperature | -70 +200°F | IC Couple | ±4°F |
| 18. | Air Intake Temperature | -70 +200°F | IC Couple | ±4°F |
| 19. | Air Intake Temperature | -70 +200°F | IC Couple | ±4°F |
| 20. | Air Intake Temperature | -70 +200°F | IC Couple | ±4°F |
| 21. | Engine Bay Temperature | 0-400°F | IC Couple | ±4°F |
| 22. | Engine Bay Temperature | 0-400°F | IC Couple | ±4°F |
| 23. | Engine Bay Temperature | 0-400°F | IC Couple | ±4°F |
| 24. | Engine Bay Temperature | 0-400°F | IC Couple | ±4°F |
| 25. | Engine Bay Temperature | 0-400°F | IC Couple | ±4°F |
| 26. | Engine Bay Temperature | 0-400°F | IC Couple | ±4°F |
| 27. | Engine Bay Temperature | 0-400°F | IC Couple | ±4°F |
| 28. | Engine Bay Temperature | 0-400°F | IC Couple | ±4°F |
| 29. | Engine Bay Temperature | 0-400°F | IC Couple | ±4°F |
| 30. | Fuel Flow | 0-5 GPM | Potter | ±.025 GPM |
| 31. | Fuel Flow | 0-5 GPM | Potter | ±.025 GPM |
| 32. | Fuel Flow | 0-5 GPM | Potter | ±.025 GPM |
| 33. | Fuel Flow | 0-5 GPM | Potter | ±.025 GPM |
| 34. | Propeller Blade Angle | ±25° | Potentiometer | ±.5° |
| 35. | Propeller Blade Angle | ±25° | Potentiometer | ±.5° |
| 36. | Forward Trunk Pressure | 0-100 psf | Press. Xducer | ±.7 psf |
| 37. | Forward Trunk Pressure | 0-100 psf | Press. Xducer | ±.7 psf |
| 38. | Rear Trunk Pressure | 0-120 psf | Press. Xducer | ±.84 psf |
| 39. | Peripheral Trunk Pressure | 0-100 psf | Press. Xducer | ±.7 psf |
| 40. | Peripheral Trunk Pressure | 0-100 psf | Press. Xducer | ±.7 psf |
| 41. | Keel Trunk Pressure | 0-100 psf | Press. Xducer | ±.7 psf |
| 42. | Stab. Trunk Pressure | 0-100 psf | Press. Xducer | ±.7 psf |
| 43. | Stab. Trunk Pressure | 0-100 psf | Press. Xducer | ±.7 psf |
| 44. | Rear Trunk Pressure | 0-120 psf | Press. Xducer | ±.84 psf |
| 45. | Cushion Pressure | 0-75 psf | Press. Xducer | ±.5 psf |
| 46. | Cushion Pressure | 0-75 psf | Press. Xducer | ±.5 psf |
| 47. | Cushion Pressure | 0-75 psf | Press. Xducer | ±.5 psf |
| 48. | Cushion Pressure | 0-75 psf | Press. Xducer | ±.5 psf |
| 49. | Pitch Attitude | ±60° | Gyro | ±.5° |
| 50. | Roll Attitude | ±60° | Gyro | ±.5° |
| 51. | Roll Rate | ±60°/sec | Gyro | ±.6 - 1.2°/sec |
| 52. | Pitch Rate | ±60°/sec | Gyro | ±.6 - 1.2°/sec |
| 53. | Yaw Rate | ±60°/sec | Gyro | ±.6 - 1.2°/sec |
| 54. | C.G. Acceleration Vertical | ±5g | Accelerometer | ±.04g |

TABLE 1.1 (Cont'd)

| PARAMETER | RANGE | SENSOR | ERROR |
|---|---|---|---|
| 55. C.G. Acceleration Long. | ±5g | Accelerometer | ±.04g |
| 56. C.G. Acceleration Lateral | ±5g | Accelerometer | ±.04g |
| 57. Bow Acceleration Vertical | ±10g | Accelerometer | ±.075g |
| 58. Air Management Pressure | 0-.5 psi | Press. Xducer | ±.0035 psi |
| 59. Air Management Pressure | 0-.5 psi | Press. Xducer | ±.0035 psi |
| 60. Air Management Pressure | 0-.5 psi | Press. Xducer | ±.0035 psi |
| 61. Air Management Pressure | 0-.5 psi | Press. Xducer | ±.0035 psi |
| 62. Air Management Pressure | 0-.5 psi | Press. Xducer | ±.0035 psi |
| 63. Air Management Pressure | 0-.5 psi | Press. Xducer | ±.0035 psi |
| 64. Air Speed | 0-100 MPH | Anemometer | ±1 MPH |
| 65. Wind Direction | ±170° | Vane | ±2.0° |
| 66. Puff Port L | ON/OFF | Switch | --- |
| 67. Puff Port R | ON/OFF | Switch | --- |
| 68. Air Management Temperature | 0-250°F | IC Couple | ±4°F |
| 69. Air Management Temperature | 0-250°F | IC Couple | ±4°F |
| 70. Strut Load Port L/H | 15K psi | Strain Gage | ±.3K psi |
| 71. Strut Load Port R/H | 15K psi | Strain Gage | ±.3K psi |
| 72. Strut Load Stbd. L/H | 15K psi | Strain Gage | ±.3K psi |
| 73. Strut Load Stbd. R/H | 15K psi | Strain Gage | ±.3K psi |
| 74. Time Code | ---- | ---- | --- |
| 75. Intercom | ---- | ---- | --- |
| 76. Event Marker | ---- | ---- | --- |

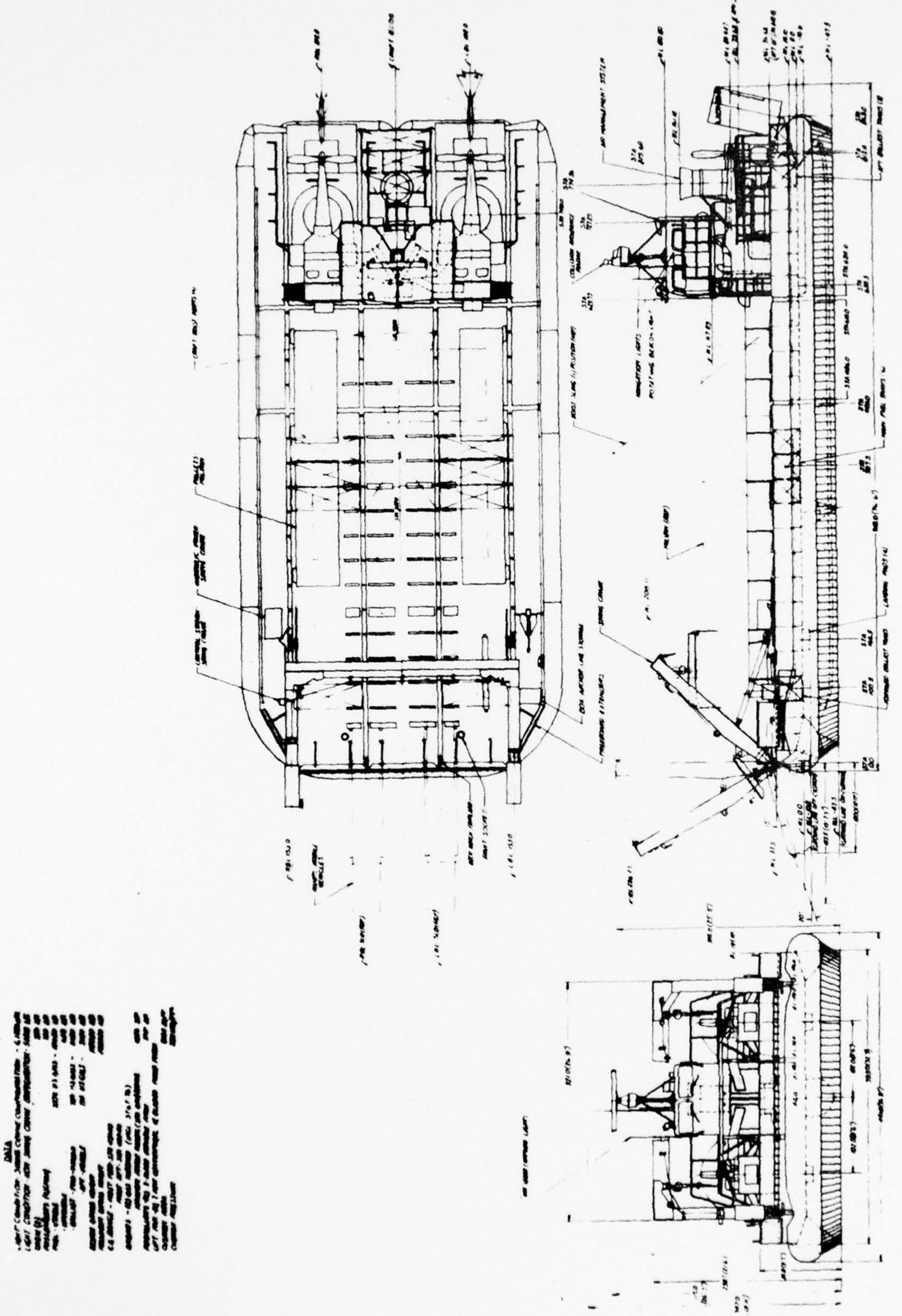

FIGURE 1.1. 3 VIEW AND GENERAL ARRANGEMENT - LACV-30

## 2.0 APPLICABLE DOCUMENTS

The specifications and documents listed below are the basis for the LACV-30 Test Program and vehicle performance.

(a) Contract No. DAAK-2-75-C-0149, U. S. Army Mobility Equipment Research and Development Center, Ft. Belvoir, Virginia, 7 March 1975.

(b) United Aircraft of Canada Limited, "Installation Manual ST6T-76 Twinned Turboshaft Engine."

(c) Pratt and Whitney Aircraft of Canada Ltd., ST6T-76 Twin Turboshaft Engine - Specific Operating Instructions," Part No. 3028241, 27 October 1975.

(d) Hamilton Standard "Model Specification for 43D50-359 Controllable Pitch Propeller Assembly," Model Specification No. MS 5088.

(e) Hamilton Standard "Model Specification for 43D50-363 Controllable Pitch Propeller Assembly," Model Specification No. 5122.

(f) Bell Aerospace Company "Technical Proposal for LACV-30-2 Instrumentation System (TECOM) Report No. 7467-953007, June 1975.

(g) Bell Aerospace Company "Calibration Requirements Summary LACV-30-2, Contract DAAK02-75-C-0149 Mod P00003 Data Item C001" Report No. 7467-956008, March 1976.

(h) Bell Aerospace Textron, "LACV-30 Pre-Delivery Water Test Program," Report No. 7467-958006, February 1978.

(i) Bell Aerospace Textron "U.S. Army Lighter ACV LACV-30 P/N 4-099001-1, Operating Manual," Report No. 7467-954001, 9 May 1977.

## 3.0 TEST PLAN

The LACV-30-1 vehicle was tested in three phases. The first phase of testing was performed at the Bell Aerospace plant in Grand Bend, Ontario, Canada. The initial tests were performed overwater with a vehicle configuration which included volutes in both lift fan plenums and the lengthened Voyageur skirt system. These tests were the pre-delivery water tests performed on Lake Huron. The tests were performed under contract No. DAAK02-75-C-0149 Mod. No. P00007 CLIN No. 0006. The pre-delivery test results are presented in the report listed as 2.0(h) in the preceding section.

The second phase of testing was performed at the BAT facility adjoining the Niagara Falls International Airport in Wheatfield, N. Y. The modified skirt system was installed prior to these tests. The final phase of testing was performed at Ft. Story, Virginia.

The LACV-30-2 vehicle was tested in two phases, the first at the BAT facility in Wheatfield, N. Y., and the second at the Aberdeen Proving Grounds (APG) in Maryland.

The proposed type and acceptance tests to be performed on both vehicles are presented in Tables 3.1 and 3.2. These tests are outlined in Contract No. DAAK02-75-C-0149 which is listed as Item 2.0(a) in the preceding section. The actual tests performed on both vehicles are presented in Table 3.3. The swing crane acceptance test was only performed on LACV-30-1 because a swing crane was not installed on the LACV-30-2. Other tests performed but not included in Tables 3.1 and 3.2 are the skirt surveys and cabin contamination tests. The results of these tests are presented in the Appendix.

TABLE 3.1. TYPE AND ACCEPTANCE TESTS (OVER LAND)

| * | TEST | (WT. AND L.C.G.) | SPEED (MPH) | SURFACE | METHOD |
|---|---|---|---|---|---|
| A | Hover | 60,000 lb., mid<br>115,000 lb., mid | | Smooth Concrete | On cushion; record hover height and trim attitudes. |
| A | SPEED RUNS | Any | 30 - limit | Any | Surveyed course; distance/time up and down wind; increments of 5 mph |
| T | Maneuvers | Any | Safe | Any | Figure - 8 turns. |
| T | Obstacles | Any | Safe | Dirt | Negotiate prepared obstacle course consisting of hump varying from 1 to 3 ft. over length and 8 foot deep ditch varying in width from 3 to 6 feet over length. Courses from minimum to maximum. |
| T | Prop Reversal Stop | Any | 25 | Any | Stop by propeller reversal at speeds of 10, 15, 20 and 25 mph. |
| A | Swing Crane | Any | | Smooth Concrete | Off cushion resting on landing pads with the engines at idle and APU operating to provide engine combustion air and electric power. |

*A - Acceptance
T - Type

TABLE 3.2. TYPE AND ACCEPTANCE TESTS
(OVER WATER)

| | *TEST | LOADING (WT. AND L.C.G.) | SPEED (MPH) | WAVE HEIGHT | METHOD |
|---|---|---|---|---|---|
| A | Hover | 60,000 lb., mid<br>115,000 lb., mid | 0 | Calm | On cushion, record hover height and trim attitudes. |
| T | Thrust Calibration | 60,000 lb., mid | 0 | Calm | On and off cushion; tether aft. Using load cells, measure static Propeller Thrust at 70, 80, 90, 95 and 100%. |
| A | Speed Runs | Any | 30 - Limit | 18 in. | Surveyed course; distance/time. Up and down wind runs; increments of 5 mph. |
| T | Crash Stop | Any | 30 - Limit | 18 in. | Simulated engines (2) failures in 5 mph steps. |
| T | Manuevers | Any | 30 - Limit | 12 in. | Figure -8 turns at increasing entry speeds; 5 mph step. |
| T | Spin Out | Any | 30 - Limit | 6 in. | Simulated critical engine failure in 5 mph steps. |
| T | Safe Operating Limits | All | AS req'd. | 30 in. | To be determined. Progressive envelope expansion from Calm Water with optimum loading to limit wave height at maximum safe speed at fwd. L.C.G. |

*A - Acceptance
T - Type

TABLE 3.3. COMPLETED TYPE AND ACCEPTANCE TESTS

| | VEHICLE | |
|---|---|---|
| ACCEPTANCE TESTS | LACV-30-1 | LACV-30-2 |
| a) OVER LAND | | |
| HOVER WITH FULL LOAD | X | X |
| HOVER WITH NO LOAD | X | X |
| GROUND SPEED | X | X |
| SWING CRANE | X | * |
| SYSTEM RUN-IN | X | X |
| b) OVER WATER | | |
| HOVER WITH FULL LOAD | X | X |
| HOVER WITH NO LOAD | X | X |
| SPEED RUNS | X | X |
| TYPE TESTS | | |
| a) OVER LAND | | |
| CABIN NOISE LEVEL | X | X |
| SKIRT PRESSURE SURVEY | X | X |
| CABIN CONTAMINATION | | X |
| OBSTACLE | | X |
| MANEUVERING | X | |
| PROPELLER REVERSAL | X | |
| b) OVER WATER | | |
| THRUST LOADING | | X |
| AIR CONDITIONING | | X |
| CABIN NOISE LEVEL | X | |
| MANEUVERING | X | |
| SAFE LIMITS | X | |
| ENGINE FAILURE CRASH | X | |
| ENGINE FAILURE SPINOUT | X | |

*SWING CRANE NOT INSTALLED

## 4.0 TEST DATA AND ANALYSIS

### 4.1 TEST DATA

The test data for all the required acceptance and type tests are presented in four tables, two test phases for each vehicle. The initial test phase on the LACV-30-1 vehicle is not discussed here since it has been reported separately. Tables 4.1 and 4.2 present LACV-30-1 test data for tests performed at BAT and Ft. Story, Virginia. Tables 4.3 and 4.4 present LACV-30-2 test data obtained from tests at BAT and Aberdeen Proving Ground .

### 4.2 ANALYSIS

#### 4.2.1 ACCEPTANCE TESTS

The analysis of the acceptance tests performed on the test vehicles is presented in the following subsections, where possible test data is compared to estimated values.

##### 4.2.1.1 HOVER TESTS

Hover acceptance tests for both of the test vehicles were satisfactory. Both vehicles were tested with full and no load, on land and over water.

##### 4.2.1.2 SPEED RUNS

The overland speed runs were required to be made in the speed range of 25 to 35 mph. The LACV-30-1 vehicle was tested at BAT and attained an average indicated air speed of 43.5 mph and a ground speed of 35 mph. The LACV-30-2 vehicle attained an average indicated air speed of 45 mph and ground speed of 36 mph.

The overwater speed test for the LACV-30-1 vehicle was performed at Ft. Story, Virginia. The vehicle attained a calibrated airspeed of 53 mph at a gross weight of 76,000 pounds. The power output of the ST6T-76 Twin Pac was 1701 horsepower. The power output was obtained using the TOP and $N_2$ readings taken during the test and inputting the data into the equation obtained from the Engine Operating Instructions listed in Section 2.0. The maximum speed of the LACV-30-1 with swing crane is presented in Figure 4.1 as a function of horsepower and average wave height for the test condition shown. The sea state

condition during the test was estimated as less than sea state 1 which means the average wave height was somewhere between 0 and 0.8 feet. The cross plot of 53 mph and 1701 horsepower in Figure 4.1 indicates an average wave height of 0.43 feet which basically verifies the speed attained.

The overwater speed test of the LACV-30-2 was performed at Aberdeen Proving Grounds. The comparison of estimated to average speed obtained in the test is shown in Figure 4.2. The average test speed of 42.5 mph is well below the predicted value of 51 mph for a 1200 horsepower lift fan and propeller input. The test data indicate that the speed runs were performed with a 2 mph cross wind. Although the cross wind is not significant, the variation of output horsepower for each Twin Pac is. According to the test data it appears that one Twin Pac was producing 1277 horsepower and the other 1121 horsepower which could indicate that propeller thrust was being used to control vehicle heading. The low power level for the test was due to operating the vehicle with uncompensated T7 limits. The vehicle engine normally operates with cmmpensated T7 limits which for the values of T7 recorded during the test would normally indicate higher power output levels.

### 4.2.1.3 SWING CRANE LOADING TESTS

The swing crane loading tests were performed at BAT on the LACV-30-1 vehicle. The test is presented in Table 4.1. The swing crane was accepted with the provision that bow pre-loaders be installed to maintain pressure on the front landing pads during swing crane operation.

### 4.2.1.4 SYSTEM RUN-IN TESTS

System run-in tests were performed on both vehicles at BAT. The only discrepancy occurred in the LACV-30-1 vehicle where it was recommended that the existing horn be replaced and rechecked.

### 4.2.2 TYPE TESTS

The analysis of the type tests performed on the test vehicles is presented in the following subsections. Where possible test data are compared to estimated values.

4.2.2.1 CABIN NOISE LEVEL

Cabin noise level tests were performed on both vehicles, the LACV-30-1 overland and water, and the LACV-30-2 overland only. Noise spectra in octave bands were measured at crew stations of the LACV-30 at full power, with the craft both stationary on cushion and at maximum speed. Significant data obtained is compared below with "Steady-State Noise Limits for Personnel Occupied Areas", Category D in Table 2 of MIL-STD-1744A(MI).

| Octave Band Center Frequency | Cat. D 8 Hr. Exposure (db) | Underway MCP (db) | Underway MAP (db) |
|---|---|---|---|
| 125 | 96 | 94 | 99 |
| 250 | 89 | 91 | 94 |
| 500 | 83 | 84 | 89 |
| 1000 | 80 | 82 | 88 |
| 2000 | 79 | 75 | 81 |
| 4000 | 79 | 66 | 71 |
| 8000 | 81 | 63 | 69 |
| db(A) | 85 | 84-Computed-90 | |

The above shows the highest levels measured; underway at maximum continuous power (MCP) and at maximum available power (MAP), a power setting limited to five (5) minutes to prevent damage to the engines. Note that the prevailing full speed operation underway at MCP (2800 eshp) closely agrees to Category D standards which permits unprotected exposure for eight hours and is based primarily on hearing conservation priorities.

To judge the compatibility of the short duration higher levels at MAP, the Walsh-Healy Act safety regulations on industrial noise exposure equates db(A) sound level with exposure time by permitting a 5 db(A) increase in noise level with a 50% reduction in time exposed. Therefore, the noise measured at MAP (3700 eshp) is acceptable for a four (4) hour continuous exposure; engine operating limits restrict MAP to five (5) minutes.

The data taken with craft stationary (1600 eshp) is generally less than that experienced underway at MCP. At the lower frequencies, the decibel level is slightly above the underway cases most probably due to propeller blade pass noise at the effective zero pitch angle required to hover. Average levels measured comply with the specified standard.

4.2.2.2 MANEUVERING

Maneuvering tests were performed with the LACV-30-1 at Ft. Story. Turn radii on land were small, 15 ft. and 20 ft. in upwind and downwind tests. No estimates have ever been made for turning radii on land.

The overwater tests were performed for two entry speeds, 40 and 30 mph, at a gross weight of 76,000 pounds. The comparison of predicted with test data is shown in Figures 4.3 and 4.4. The turning radii obtained from the tests were estimated The turning radius for an entry speed of 40 mph was in good agreement with predicted as shown in Figure 4.3. The turning radius for an entry speed of 30 mph was substantially lower than predicted as can be seen in Figure 4.4. Further testing at other test conditions would be required to substantitate the predicted values.

4.2.2.3 OBSTACLE TESTS

Obstacle crossing tests were performed at Aberdeen Proving Grounds using the LACV-30-2 vehicle. In the ditch crossing test the ditch measured 10 feet wide at the crossing point. The ditch crossing speed was an indicated air speed (IAS) of 22 mph. The second obstacle crossed was a three-foot high step. The test was performed at an IAS of 33 mph. The vehicle performed satisfactorily in both tests.

4.2.2.4 SAFE LIMITS

The safe operating limits overwater were performed to demonstrate that the vehicle would not "plow in" at selected speeds and yawed conditions. Tests were performed with the LACV-30-1 vehicle at entering yaw angles of 0 and 30 degrees at an IAS of 45 mph. No adverse behavior was recorded.

4.2.2.5 ENGINE FAILURE -"CRASH STOP"

"Crash stop" tests were performed overwater with the LACV-30-1 vehicle at Ft. Story. The tests were performed to demonstrate vehicle conditions with the loss of power from both engines. The tests were performed at a yaw angle of 0 degrees at a cut-off IAS of 40 mph and at a 30 degree yaw angle at a cut-off IAS of 45 mph. The vehicle exhibited no adverse behavior.

4.2.2.6 ENGINE FAILURE - "SPINOUT"

"Spinout" tests were performed on the LACV-30-1 vehicle at Ft. Story. The tests were performed to demonstrate the vehicle under a simulated engine failure condition with optimum trim from a target speed of 10-50 mph. The selected engine to be cut was at the discretion of the operator. The tests were performed at a yaw angle of 0 degrees at a cut-off IAS of 40 mph and a yaw angle of 30 degrees with a cut-off IAS of 30 mph. After engine cut-off the vehicle yawed in the direction of the cut-off engine and sideslipped until the operator took corrective action. The estimated maximum roll angle incurred during the test was 25 degrees. The corrective action taken by the operator for restoring vehicle control was to reduce power on the opposite engine. The recovery action successfully corrected the unusual vehicle attitude.

4.2.2.7 THRUST LOADING

The thrust loading test was performed at APG with the LACV-30-2 vehicle hovering overwater. The vehicle was tethered to a government furnished measuring device to determine thrust of the 43D50-363 propeller over a range of engine settings. Due to the inability of maintaining the vehicle normal to the tether point, the values obtained in the test were not considered to be the maximum available.

The test was repeated overland. The vehicle was tethered at the stern to a GFE thrust measurement van which was used to determine the net forward force. A bridle on the starboard side restrained the vehicle from lateral movement. A total of seven test points were obtained. The test conditions were:

$T_{AMB}$ = $80^{\circ}F$

$V_{WIND}$ = 4 MPH

BAROMETER = 29.95 inHg

$W_G$ = 85,000 Lb. (empty MILVAN's placed on deck)

The results of the analysis are presented in Table 4.5. The predicted propeller data provided by Hamilton Standard has a minimum Cp value of 0.07, therefore no comparison to predicted can be made for the first three test points. Test points 4, 5 and 6 indicate that the resulting performance of the propellers was within 10% of the predicted, while the test point 7 was within 3% of predicted. No angles of attack were recorded during the test, therefore cushion thrust effects have not been included in the analysis.

4.2.2.8 AIR CONDITIONING

Air conditioning tests were performed overwater on the LACV-30-2 vehicle at Ft. Story. The outside temperature was $101^{\circ}F$. At the end of the test, 30 minutes later, the cabin temperature dropped to $78^{\circ}F$. The test results were satisfactory and accepted by the U. S. Army.

4.2.2.9 PROPELLER REVERSAL

The overland stop tests were performed on the LACV-30-1 vehicle at BAT. The propeller reverse thrust was used to stop the craft. The stopping time from an IAS of 45 mph was 56 seconds. The stopping distance was 1600 feet. The test results were accepted by the U. S. Army.

4.2.2.10 CABIN CONTAMINATION

The cabin contamination tests were performed on the LACV-30-2 vehicle at BAT. The data is presented in Appendix A. The measured noxious fumes were in allowable limits and were acceptable for habitation.

4.2.2.11 SKIRT PRESSURE SURVEY

The skirt pressure survey was performed at BAT on both of the test vehicles. The tests were not required as part of the acceptance test program. The report presenting the test data and results is presented in Appendix B to provide a complete data package for both of the vehicles.

TABLE 4.1. LACV-30-1 TESTS AT BAT

THIS TABLE CONSISTS OF A SERIES OF TEST PLANS FOLLOWED BY TEST DATA.

| BELL AEROSPACE ACV TEST PLAN | TYPE LACV-30-1 | OPER. NO. A1-0218 |
|---|---|---|

| ACV CREW | | NO CHASE AIRCRAFT | | TEST CONDITIONS | | |
|---|---|---|---|---|---|---|
| CREW POSITION | NAME | TYPE A/C | CREW | | TAKEOFF | LAND |
| Operator | D. Hall | | | WEIGHT | 115,000 | TBD |
| Co-Operator | G. Yaeger | | | FUEL | See Loading 4 | |
| U.S.A. Obs. | J. Sargent | | | C.G. | – | – |
| | H. Woods | INSTRUMENTATION PLAN NONE | | BALLAST | – | – |
| | L/C Pope | SETUP NO. | AMEND NO. | ALT SETTING | | |
| | | RADIO FREQ. | | PRESS ALT | | |
| TEST ENGINEER | C. Stauffer | UHF | 121.7 | WIND | | |
| TEST DIRECTOR | " | UHF-FM | 6 | TEMP | | |
| FINAL GO-NO GO AUTHORITY | " | VHF-FM | TBD | RECORD ABOVE DATA | | |

**CRAFT CHANGES SINCE LAST OPERATION**

Air Management Instrumentation removed (less pressure taps).

**TEST PURPOSE**

A. Demonstration to U.S. Army for acceptance:
   1. Hover with full load.
   2. System run-in tests
   3. Cabin noise level (stationary)

| TEST ENGINEER | OPER. IN COMMAND | APPROVAL |
|---|---|---|
| C. L. Stauffer | | J Sargent |

**TEST PROCEDURE**

I. Position craft on BAC concrete ramp north of production hangar. restrain as required for wind and slope.

II. Perform Operator Inspection IAW Checklist.

III. Perform normal pre-start, start, etc. IAW Checklists.

IV. Raise craft in hover mode

   A. Conduct acceptance tests (DAAK02-75-C-0149, Attachment I, Pages 10 and 11).

      1. Hover with full load per Attachment I (Ref. Item 9(A)2)A.
      2. Perform system run-in tests per Attachment 2 (Ref. Item 9(A)3)A & B).
      3. Obtain cabin noise level data per Attachment 3 (Ref. Item 9(A)5)

V. Secure craft as required for cargo handling tests.

U.S. ARMY ACCEPTANCE

LACV-30-1

# LAND HOVER WITH FULL LOAD

1. Verify craft configured per Loading 4 (115,000 lb. G.W.).
2. In cushion mode, trim and perform a 15 minute demonstration at $N_2$ maximum (91% $N_2$ minimum).
3. Manually record the following data:

| | START | | | | COMPLETE | | | |
|---|---|---|---|---|---|---|---|---|
| Time | 1530 | | | | 1640 | | | |
| Fuel (Fwd) | 54% | 54% | | | 54% | 54% | | |
| (Main) | 80% | 75% | | | 75% | 75% | | |
| (Aft) | 52% | | | | 52% | | | |
| $T_7$ (°C) | 405 | 465 | 450 | 420 | 405 | 465 | 450 | 420 |
| $N_1$ (%) | 85.5 | 89.0 | 86.5 | 86.0 | 85.5 | 89.0 | 86.5 | 86.0 |
| $N_2$ (%) | 91 | 91 | 91 | 91 | 91 | 91 | 91 | 91 |
| Torque (psi) | 18 | 18 | 16 | 18 | 18 | 18 | 16 | 18 |

COMMENTS:

All operations satisfactory.

COMPLETED ____________________ BAC

VERIFIED ____________________ BAC QUALITY

ACCEPTED ____________________ U.S.A. REPRESENTATIVE

19 Feb 76

U.S. ARMY ACCEPTANCE

LACV-30-1

SYSTEM RUN-IN TESTS

1. Starting concurrent with Hover (Attachment 1) and continuing off cushion for a total of one hour, functionally operate the following systems:

Start Time 1530 Complete Time 1640

| | BAC | U.S.A. |
|---|---|---|
| Puff Ports (20 cycles each) | [illegible] | [illegible] (19 Feb 76) |
| Cabin Heaters (Both, Lo and Hi) | [illegible] | [illegible] |
| Windshield Heat (Continuous) | [illegible] | [illegible] |
| Air Conditioner (Vent & Cool) | [illegible] | [illegible] |
| APU (Generator On) | [illegible] | [illegible] |
| AN/URC-80 (4 Contacts) | [illegible] | [illegible] |
| AN/URC-46 (4 Contacts) | [illegible] | [illegible] |
| AN/PRC-94 (4 Contacts) | [illegible] | [illegible] |
| RMHS System (Continuous) | [illegible] | [illegible] |
| AN/ASN-43 Compass (Continuous) | [illegible] | [illegible] |
| Radar (Continuous) | [illegible] | [illegible] |
| Fuel Trim (To/From Transfers) | [illegible] | [illegible] |
| Engines (Continuous) | [illegible] | [illegible] |
| Propellers (As Required) | [illegible] | [illegible] |
| Windshield Wipers (4 Cycles) | [illegible] | [illegible] |
| Spotlight (4 Cycles) | [illegible] | [illegible] |
| Running Lights (Continuous) | [illegible] | [illegible] |
| Horn (4 Blasts) | | |

DISCREPANCIES AND DISPOSITION:

RMHS operative; needs repeat Compass Swing. Will be accomplished during BAC tests at Fort Storey.

Existing horn will be replaced; recheck as above.

COMPLETED G. Yaeger
BAC

ACCEPTED John J. Sargent
U.S.A. REPRESENTATIVE
19 Feb 76

VERIFIED Fred Mueller
BAC QUALITY

U.S. ARMY ACCEPTANCE

LACV-30-1

CABIN NOISE LEVEL - STATIONARY

1. Concurrent with Attachment 1, conduct survey with engines at full power ($N_2$ maximum). Using an Octive-Bad Noise Analyzer, record noise levels at ear level.

| | Operator | | Freq. | Passenger | |
|---|---|---|---|---|---|
| | (Raw) | (Corr.) | (Hertz) | (Raw) | (Corr.) |
| Band 1 | 48 | 48.9 | 16000 | 48 | 48.9 |
| 2 | 60 | 60 | 8000 | 60 | 60 |
| 3 | 61 | 58 | 4000 | 60 | 57 |
| 4 | 68 | 68.2 | 2000 | 67 | 67.2 |
| 5 | 74 | 74 | 1000 | 73 | 73 |
| 6 | 82 | 81.8 | 500 | 82 | 81.8 |
| 7 | 92 | 92 | 250 | 94 | 94 |
| 8 | 125 | 125.7 | 125 | 105 | 105.6 |

Record engine parameters.

| | | | | | | |
|---|---|---|---|---|---|---|
| $N_1$ (%) | | 85.5 | 89.0 | 86.5 | 86.0 | |
| $N_2$ (%) | | 91 | 91 | 91 | 91 | |
| Torque (psi) | 17 | 18 | | 16 | 18 | |
| Prop. Pitch | | -5 | | -5 | | |

Record Model and Serial No. of Test Equipment.

General Radio Model 1558AP Octave Band Noise Analyzer, S/N 732.

Attach Calibration Sheets.

COMPLETED W C Yaeger
BAC

VERIFIED Fred Mueller
BAC QUALITY

ACCEPTED John J. Sargent
U.S.A. REPRESENTATIVE

BAC 1972

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CALIBRATION PROCEDURE NUMBER Q0644

REVISION

## CALIBRATION DATA SHEET

| NOMENCLATURE | MANUFACTURER | MODEL NO. |
|---|---|---|
| OCTAVE BANDWIDTH ANALYZER | GEN. RADIO | 1558-AP |
| **FILE NO.** | **TECH.** | **CALIBR. DATE** |
| 3260053 | S.R. MITROWSKI | 5-19-75 |

## CALIBRATION EQUIPMENT

| FILE NO. | | | |
|---|---|---|---|
| | VTVM | BALLANTINE | 300 |
| 1050002 | VTVM | HP | 400D |
| 1910003 | DECADE ATTEN | GR | 1450 |
| 2580002 | OSC | HP | 205AG |
| | OSC | HP | 200CD |
| 2050003 | COUNTER | B. KECLEY | 7370 |
| 3280001 | MIC RESP CAL | GR | 1559B |
| 3010001 | TRANSDUCER ADAPTOR | GR | 1995-9139 |
| | MICROPHONE | GR | |
| | | | |
| | | | |
| | | | |

## CALIBRATION DATA

| PARA./ STEP NO. | FUNCTION TESTED | MEASUREMENT DATA NOMINAL | MEASURED | CORRECTED | TOLERANCES | |
|---|---|---|---|---|---|---|
| | BAND LEVEL DB | | | | | |
| | OUTTER DIAL INNER | | | | | |
| | POS DIAL | STD SET | — | | ±1.0DB | |
| | 50 (6) 1 | 90 | none | | | |
| | 60 (5) 1 | 80 | -0.1 | | | |
| | 70 (4) 1 | 70 | -0.2 | | | |
| | 80 (3) 1 | 60 | -0.1 | | | |
| | 90 (2) 1 | 50 | -0.1 | | | |
| | 100 (1) 1 | 40 | REF 0 DB | | | |
| | (1) 110 | 30 | -0.1 | | | |
| | (1) 120 | 20 | -0.1 | | | |
| | (1) 130 | 10 | -0.1 | | | |
| | (1) 140 | 0 | -0.1 | | ±1.0DB | |
| | | | | | | |
| | METER CHECK | | | | | |
| | | | | | | |
| | OUTTER INNER | | | | | |
| | DIAL DIAL | STD | | | | |
| | POS 4 (OUT) POS 4 (OUT) | SET | | | | |
| | (4) (4) | 45 | -5.0 | | | |
| | (4) (4) | 44 | -4.0 | | | |
| | (4) (4) | 42 | -2.0 | | | |
| | (4) (4) | 40 | REF 0 | | | |
| | (4) (4) | 38 | +2.0 | | | |
| | (4) (4) | 36 | +4.0 | | | |
| | 4 (4) | 32 | +8.0 | | | |
| | (4) (4) | 30 | +10.0 | | | |
| | (4) (4) | | | | | |



FILE NO. 3260053

PROCEDURE NO. Q0644

# CALIBRATION DATA

GR 1558 AKS

| PARA. STEP NO. | FUNCTION TESTED | NOMINAL | MEASURED | CORRECTED | TOLERANCES | |
|---|---|---|---|---|---|---|
| | BAND PASS DIAL | FREQ | | | | |
| | ½ LOW CUTOFF | 11.15 | >30 db | | >30 DB | |
| | LOW CUTOFF | 22.3 | -3.0 | | 3.5 DB | ±1 DB |
| 31.5 | CENT FREQ | 31.5 | 1.0 db | | ±1 DB | |
| | HIGH CUTOFF | 44.6 | 2.5 " | | 3.5 DB | ±1 DB |
| | 2X HIGH CUTOFF | 89.2 | >30 " | | >30 DB | |
| | ½ LOW | 22.3 | >30 db | | >30 DB | |
| | LOW | 44.6 | -3.0 " | | 3.5 DB | ±1 DB |
| 63 | CENT FREQ | 63 | -0.8 " | | ±1 DB | |
| | HIGH | 89.2 | -2.6 " | | 3.5 DB | ±1 DB |
| | 2X HIGH | 178.4 | >30. " | | >30 DB | |
| | ½ LOW | 44.6 | >30 db | | >30 DB | |
| | LOW | 88.4 | -2.6 " | | 3.5 DB | ±1 DB |
| 125 | CENT FREQ | 125 | +0.7 " | | ±1 DB | |
| | HIGH | 177 | -3.0 " | | 3.5 DB | ±1 DB |
| | 2X HIGH | 354 | >30. " | | >30 DB | |
| | ½ LOW | 88.4 | >30 db | | >30 DB | |
| | LOW | 177 | -2.2 " * | | 3.5 DB | ±1 DB |
| 250 | CENTER FREQ | 250 | 0.0 " | | ±1 DB | |
| | HIGH | 354 | -3.0 " | | 3.5 DB | ±1 DB |
| | 2X HIGH | 707 | >30. " | | >30 DB | |
| | ½ LOW | 177 | >30 db | | >30 DB | |
| | LOW | 354 | -2.2 " * | | 3.5 DB | ±1 DB |
| 500 | CENTER | 500 | -0.2 " | | ±1 DB | |
| | HIGH | 707 | -4.0 " | | 3.5 DB | ±1 DB |
| | 2X HIGH | 1414 | >30 " | | >30 DB | |
| | ½ LOW | 354 | >30 db | | >30 DB | |
| | LOW | 707 | -2.8 " | | 3.5 DB | ±1 DB |
| 1000 | CENTER | 1000 | 0.0 " | | ±1 DB | |
| | HIGH | 1414 | -4.0 " | | 3.5 DB | ±1 DB |
| | 2X HIGH | 2828 | >30 " | | >30 DB | |
| | ½ LOW | 707 | >30 db | | >30 DB | |
| | LOW | 1414 | -2.0 " * | | 3.5 DB | ±1 DB |
| 2000 | CENTER | 2000 | +0.2 " | | ±1 DB | |
| | HIGH | 2828 | -3.0 " | | 3.5 DB | ±1 DB |
| | 2X HIGH | 5656 | >30. " | | >30 DB | |
| | ½ LOW | 2828 | >30 db | | >30 DB | |
| | LOW | 5656 | -4.5 " | | 3.5 DB | ±1 DB |
| 8000 | CENTER | 8000 | 0.0 " | | ±1 DB | |
| | HIGH | 11310 | -3.2 " | | 3.5 DB | ±1 DB |
| | 2X HIGH | 22620 | >30. " | | >30 DB | |
| | ½ LOW | 5656 | >30. db | | >30 DB | |
| | LOW | 11310 | -2.8 " | | 3.5 DB | ±1 DB |
| 16000 | CENTER | 16000 | +0.9 " | | ±1 DB | |
| | HIGH | 22620 | -3.0 " | | 3.5 DB | ±1 DB |
| | 2X HIGH | 45200 | >30. " | | >30 DB | |
| | ½ LOW | 1414 | >30 db | | >30 DB | |
| | LOW | 2828 | -1.6 " * | | 3.5 DB | ±1 DB |
| 4000 | CENTER | 4000 | +0.8 " | | ±1.0 DB | |
| | HIGH | 5656 | -3.0 " | | 3.5 DB | ±1 DB |
| | 2X HIGH | 11320 | >30. " | | >30 DB | |

* LIMITED USE

| BELL AEROSPACE ACV TEST PLAN | TYPE LACV-30-1 | OPER. NO. A2-0219 |
|---|---|---|

| ACV CREW | | NO CHASE AIRCRAFT | | TEST CONDITIONS | | |
|---|---|---|---|---|---|---|
| CREW POSITION | NAME | TYPE A/C | CREW | | TAKEOFF | LAND |
| Operator | Hall | | | WEIGHT | Not applicable | |
| Co-Operator | Yaeger | | | FUEL | | |
| Crew | Finch | | | C.G. | | |
| " | Greenspan | INSTRUMENTATION PLAN | | BALLAST | See Loading 4 | |
| U.S.A. Obs. | J. Sargent | SETUP NO. | AMEND NO. | ALT SETTING | | |
| | | RADIO FREQ. | | PRESS ALT | | |
| TEST ENGINEER | Stauffer | Not Required | | WIND | | |
| TEST DIRECTOR | " | | | TEMP | | |
| FINAL GO-NO GO AUTHORITY | " | | | RECORD ABOVE DATA | | |

| CRAFT CHANGES SINCE LAST OPERATION | TEST PURPOSE |
|---|---|
| NONE | A. Demonstration to U.S. Army for acceptance:<br>1. Off load 2 MILVANS with swing crane. |

| TEST ENGINEER | OPER. IN COMMAND | APPROVAL |
|---|---|---|
| C. L. Stauffer | | J. Sargent |

TEST PROCEDURE

I. Position craft on BAC concrete ramp. In the event of adverse weather, hangar craft on North Side of Flight Test Hangar. (In hangar, external 400 hertz power to be used in lieu of APU.)

II. Perform Operator Inspection IAW Checklist.

III. Perform sections of normal pre-start, start, etc. required for APU (Generator On) operation. Man the operators position for periods when APU is operating.

IV. With craft on landing pads:

A. Conduct acceptance tests (DAAK02-75-C-0149, Attachment I, Page 11)

1. Swing crane off-load MILVANS per Attachment 1 (Ref. Item 9(A)6).

V. Secure craft and prepare for taxi tests (A3-0220).

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B. Swing Crane Operations

The LACV-30 will be off cushion resting on its landing pads with the engines at idle and the APU operating to provide engine combustion air and electrical power. Observe precautions in Chapter 2, Section 3. The basic functions and sequence are as follows:

(1) The crewmen exit the cabin.

(2) Unlash the MILVANS.

(a) Slide the lock and pull handle on tensioner assembly to open position.

(b) Remove beaded assembly from tensioner.

(c) Remove beaded assembly from the MILVAN corner fitting.

(d) Remove tensioner assembly from the cargo tiedown fitting by removing the screw pin from the shackle and removing the shackle from the deck fitting. Reinstall the screwpin.

(e) Stow all lashings.

(3) Unlash load spreader pallets.

(a) Slip lines from the bollard.

(b) Unhook the line from pallet "D" ring.

(c) Stow all lines.

(4) Unlash chain hoists and lifting beams, stow lashings.

(5) Pull pins on outboard surf fence struts, swing forward and stow and repin. Install surf fence locks between surf fence sections.

(6) Pull swing crane transportation stow pins.

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(7) Engage tow chain in pallet chain fitting (2 forward pallets) and pin in position. Place tail of chain on pallets. Raise pallet tierod to UP position.

(8) Start hydraulic power unit.

WARNING

KEEP HANDS AND FEET CLEAR OF MOVING CHAIN, PULLEY, TIEROD AND HYDRAULIC ACTUATOR, ASSURE PALLETS AND CHAIN DO NOT SNAG OR JAM DURING FORWARD MOVEMENT.

(9) Operate swing crane forward. The two forward pallets and MILVAN will move forward approximately 13 ft.

WARNING

KEEP HANDS AND FEET CLEAR OF MOVING OR ROTATING EQUIPMENT.

(10) Operate swing crane aft, disengage pin and chain from both pallets, replace in, and simultaneously pull the port and starboard chain aft keeping the chain under tension and free of obstructions.

(11) Stop the crane when the limit blocks are aft of the pallet tow chain fittings.

(12) Re-engage tow chains in the pallet tow fittings. The nylon limit block must be forward of the tow fitting and as close to the fitting as possible with an equal number of links between fittings and limit blocks port and starboard. Replace pin. Place tail of chain on pallets.

WARNING

IF, DUE TO POSITION OF MILVAN ON PALLET, THE TIEROD WILL HIT THE SURF FENCE STRUTS — REMOVE THE TIEROD AND STORE ON FWD. DECK.

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(13) Operate swing crane to position the front edge of MILVAN at guide mark on deck.

(14) Position swing crane to VERTICAL POSITION.

(15) Disengage chain from pallet tow fitting both sides. Replace pin.

(16) Attach snatch block from winch swing crane to jack assembly.

(17) Unlock jack and lower to ground.

(18) Repeat for opposite jack.

(19) Rotate jack pad 90 degrees. Jack swing crane tierod end to top of lateral support fitting.

(20) Repeat for opposite jack and secure winch.

(21) Operate swing crane to full aft position, simultaneously pulling the tow chain aft keeping the chain under tension and free of obstructions.

(22) Lower chain fall and lifting beam to top of MILVAN and engage beam hooks in MILVAN. Raise chain-fall to pretension the hooks.

<u>CAUTION</u>

BE CERTAIN BOW TRUNK SKIRTS ARE UNDER THE CRAFT SO TRAILER DOES NOT RUN OVER THEM.

(23) Move tractor/trailer into position.

<u>WARNING</u>

ENSURE THAT THE TOW CHAINS DO NOT CATCH ON PALLETS, CURBS. TIEDOWN FITTINGS OR THE HOIST HAND CHAIN DOES NOT ENGAGE THE SURF FENCE.

(24) Operate swing crane to lift MILVAN from the deck to the trailer.

(25) Lower chain fall and position MILVAN on trailer. Use tag lines if required.

(26) Disengage beam hooks from the MILVAN and operate chain hoist to raise the beam back up to position.

When only one MILVAN is to be unloaded, proceed to step 45. If a second MILVAN is to be unloaded, proceed as follows:

(27) Operate swing crane to aft position simultaneously pulling the tow chains aft keeping tension on the chains and free of obstructions.

NOTE

TRAILER CAN BE MOVED OUT.

(28) Remove pallet tierods and place on fwd deck.

(29) Attach pallet tiedown ropes to "D" rings of pallets and position pallets to center of deck.

(30) Engage tow chain in pallet chain fitting (2 aft pallets) and pin in position. Place tail of chain on pallets. Raise pallet tierod to UP position.

WARNING

KEEP HANDS AND FEET CLEAR OF MOVING CHAIN, PULLEY, TIEROD AND HYDRAULIC ACTUATOR. ASSURE PALLETS AND CHAIN DO NOT SNAG OR JAM DURING FORWARD MOVEMENT.

(31) Operate swing crane forward. The two pallets and MILVAN will move forward approximately 13 ft.

WARNING

KEEP HANDS AND FEET CLEAR OF MOVING OR ROTATING EQUIPMENT.

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(32) Operate swing crane aft, disengage pin and chain from both pallets, replace pin, and simultaneously pull the port and starboard chain aft keeping the chain under tension and free of obstruction.

(33) Reengage tow chains in pallet chain fittings and pin in position. Place tail of chains on pallets.

WARNING

KEEP HANDS AND FEET CLEAR OF MOVING CHAIN, PULLEY, TIEROD AND HYDRAULIC ACTUATOR. ASSURE PALLETS AND CHAIN DO NOT SNAG OR JAM DURING FORWARD MOVEMENT.

CAUTION

ASSURE THE PALLET TIEROD IS IN THE UP POSITION AND OBSERVE THAT TIEROD AND MILVAN TRAVERSE THE TWO PALLETS ON CENTER OF DECK.

(34) Operate swing crane forward.

WARNING

KEEP HANDS AND FEET CLEAR OF MOVING OR ROTATING EQUIPMENT.

(35) Operate swing crane aft, disengage pin and chain from both pallets, replace pin, and simultaneously pull the port and starboard chain aft keeping the chain under tension and free of obstructions.

(36) Stop the crane when the nylon limit blocks are aft of the pallet tow chain fittings.

(37) Re-engage tow chains in the pallet tow fittings. The nylon limit block must be forward of the tow fitting and as close to the fitting as possible with an equal number of links between fittings and limit blocks port and starboard. Replace pin. Place tail of chain on pallets.

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(38) Operate swing crane to position the front edge of MILVAN at guide mark on deck. As the pallets/MILVAN moves forward observe the tierod assembly in the lateral support fitting. If the rod assembly moves out of the supporting fitting, adjust the jacks to lower the tierod assembly back into position.

(39) Operate swing aft, disengage chain from pallet tow fitting both sides. Replace pin and pull tow chains aft.

(40) Lower chain fall and lifting beam to top of MILVAN and engage beam hooks in MILVAN. Raise chain fall to pretension the hooks.

CAUTION

BE CERTAIN BOW TRUNK SKIRTS ARE UNDER THE CRAFT SO TRAILER DOES NOT RUN OVER THEM.

(41) Move tractor/trailer into position.

WARNING

ENSURE THAT THE TOW CHAINS DO NOT CATCH ON PALLETS, CURBS OR TIEDOWN FITTINGS.

(42) Operate swing crane to lift MILVAN from the deck to the trailer.

(43) Lower chain fall and position MILVAN on trailer. Use tag lines if required.

(44) Disengage beam hooks from the MILVAN and operate chain hoist to raise the beam back up to position.

(45) Operate the swing crane to the vertical position simultaneously pulling the chains aft. Keeping tension on the chains and free of obstruction.

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NOTE

MOVE THE TRAILER OUT.

(46) Raise the jack pads and repin the tierods in the lateral support fitting, both sides.

(47) Attach the winch hook to the jack and hoist to the stow position and latch onto the gantry.

(48) Repeat for opposite jack and secure winch.

(49) Reposition and repin surf fence struts. Remove surf fence locks and stow.

(50) Operate swing craft aft simultaneously pulling the chains aft. Keeping tension on chains and free of obstructions.

(51) Attach pallet tiedown ropes and manually pull aft pallets to position as marked on deck.

(52) Repeat for the fwd pallets.

(53) Secure the chain hoists and lift beams.

(54) Lash pallets to deck with 4-150070-33 rope assemblies.

(55) Reposition the pallet tierods between the aft pallets and between the fwd pallets.

(56) Secure the tow chains.

U.S. ARMY ACCEPTANCE

LACV-30-1

SWING CRANE MILVAN OFF-LOAD

The acceptance tests as defined in this attachment were accomplished.

COMMENTS:

Accepted with understanding that a hydraulic actuation will insure contact of the forward skids with ground surface when a fully loaded MILVAN (44,800 lbs) is over center, forward, to prevent load runaway.

COMPLETED C. J. S[illegible]
BAC

ACCEPTED [illegible] J. Sargent
U.S.A. REPRESENTATIVE
19 Feb 76

VERIFIED Fred Mueller 2/19/76
BAC QUALITY

| BELL AEROSPACE ACV TEST PLAN | TYPE LACV-30-1 | OPER. NO. A3-0220 |
|---|---|---|

| ACV CREW | | NO CHASE AIRCRAFT | | TEST CONDITIONS | | |
|---|---|---|---|---|---|---|
| CREW POSITION | NAME | TYPE A/C | CREW | | TAKEOFF | LAND |
| Operator | Hall | | | WEIGHT | | TBD |
| Co-Operator | Yaeger | | | FUEL | Loading | No. 5 |
| U.S.A. Obs. | | | | C.G. | - | - |
| | | INSTRUMENTATION PLAN None | | BALLAST | 0 | 0 |
| | | SETUP NO. | AMEND NO. | ALT SETTING | | |
| | | RADIO FREQ. | | PRESS ALT | | |
| TEST ENGINEER | Stauffer | VHF | 121.7 | WIND | | |
| TEST DIRECTOR | " | VHF-FM | P 55.85 S 85.55 | TEMP | | |
| FINAL GO-NO GO AUTHORITY | " | UHF-FM | 6 | RECORD ABOVE DATA | | |

**CRAFT CHANGES SINCE LAST OPERATION**

MILVANS and associated hardware removed.

**TEST PURPOSE**

A. Demonstration to U.S. Army for acceptance:

1. Hover with no load.
2. Maneuvering (8's).
3. Speed Run (25-35 mph)
4. Prop Reversal Stop from $\gtrsim$ 25 mph.

| TEST ENGINEER | OPER. IN COMMAND | APPROVAL |
|---|---|---|
| C. L. Stauffer | | J Hargent |

**TEST PROCEDURE**

I. Position craft on BAC concrete ramp north of Production Hangar. Restrain as required for wind and slope.

II. Perform Operator Inspection IAW Checklist.

III. Perform normal pre-start, start, etc. IAW Checklists.

IV. Operate craft and systems as required:

A. Conduct acceptance tests (DAAK02-75-C-0149, Attachment I, Page 11)

1. Hover without load per Attachment 1 (Ref. Item (9)(a)2)a)
2. After release of restraints, taxi to preselect area on NFIAP. Maneuver (8's) per Attachment 2 (Ref. Item (9)(a)2)c)
3. Perform speed runs per Attachment 3 (Ref. Item (9)(a)2)b)
4. On any 25 mph run, accomplish stop using full propeller reversal per Attachment 4 (Ref. Item (9)(a)2)e).

V. Return to BAC Ramp and secure craft.

U.S. ARMY ACCEPTANCE

LACV-30-1

OVERLAND HOVER WITHOUT LOAD

1. Verify craft configured per loading 5 (≃85,000 lb. G.W.).

2. In cushion mode, trim and perform a 15 minute demonstration at $N_2$ maximum (91% $N_2$ minimum).

3. Manually record the following data:

| | START | | | | COMPLETE | | | |
|---|---|---|---|---|---|---|---|---|
| Time | 1,342 | | | | 1,357 | | | |
| Fuel (Fwd) | 55% | | 55% | | 55% | | 55% | |
| (Main) | 65% | | 65% | | 65% | | 65% | |
| (Aft) | 48% | | | | 48% | | | |
| T7 (°C) | 405 | 460 | 450 | 430 | 405 | 460 | 450 | 430 |
| $N_1$ (%) | 85.0 | 87.5 | 87.0 | 86.0 | 85.0 | 87. | 87. | 86. |
| $N_2$ (%) | 91 | 91 | 91 | 91 | 91 | 91 | 91 | 91 |
| Q (psi) | 22 | 22 | 21 | 25 | 22 | 22 | 21 | 25 |

COMMENTS:

COMPLETED [illegible signature]
BAC

ACCEPTED [illegible signature] 20 Feb 76
U.S.A. REPRESENTATIVE

VERIFIED Fred Mueller 2/20/76
QUALITY

U.S. ARMY ACCEPTANCE

LACV-30-1

OVERLAND MANEUVERING (8's)

1. Determine wind direction in the test area.

2. At a safe maneuvering ground speed (5 to 10 mph) perform "8" approximately up and down wind.

3. Record time through each (2) 360°.

   Upwind 15 Secs. Downwind 20 Secs.

4. Record wind direction 260 Velocity 5 mph.

5. As practicable, record turn radii.

   Upwind 15 Ft. Downwind 20 Ft.

6. COMMENTS:

COMPLETED C. T. Stauffer
BAC

ACCEPTED 20 FEB 76
U.S.A. REPRESENTATIVE

VERIFIED Fred Mueller 2/20/76
BAC QUALITY

U.S. ARMY ACCEPTANCE

LACV-30-1

OVERLAND SPEED RUNS (25 TO 35 mph)

1. Determine wind direction in the Test Area.

2. Record Wind Direction 260, Velocity 5 mph.

3. On wind dependent course selected, perform two reciprocal runs at speed from 25 to 35 mph (estimated).

4. Record IAS, ground speeds attained and measurement method (pacer, time/dist., other).

| | IAS (mph) | GS (mph) | Method |
|---|---|---|---|
| Run 1 | 42 | 37 | Time Distance |
| Run 2 | 45 | 33 | " " |
| Average | 43.5 | 35 | " " |

5. COMMENTS:

COMPLETED C. T. Stutt[illegible]
BAC

ACCEPTED J. [illegible] 20 Feb 76
U.S.A. REPRESENTATIVE

VERIFIED Fred Mueller 2/20/76
BAC QUALITY

U.S. ARMY ACCEPTANCE

LACV-30-1

OVERLAND STOP (>25 mph)

1. In conjunction with "OVERLAND SPEED RUNS" (Attach. 3), perform a stop from any attained speed over 25 mph using normal propeller reversal techniques.

2. Record

| | | | | |
|---|---|---|---|---|
| Attained Speed (mph) | 45 | IAS | 37 | GS |
| Stopping Distance | 1,600 | Ft. | Scale | (Method) |
| Stopping Time | 56 | Sec. | | |
| Inst. Obs. (Av.) | RUN | (Reference | STOP | (Max.) |
| $T_7$ (°C) | 450 | | 450 | |
| $N_1$ (%) | - | | - | |
| $N_2$ (%) | 92 | | 92 | |
| Q (psi) | 34 | | 36 | |

3. COMMENTS

COMPLETED C. S. Stauffer
BAC

ACCPETED [signature] 20 Feb '76
U.S.A. REPRESENTATIVE

VERIFIED Fred Mueller 2/20/76
BAC QUALITY

TABLE 4.2. LACV-30-1 TESTS AT FT. STORY

THIS TABLE CONSISTS OF A SERIES OF TEST PLANS FOLLOWED BY TEST DATA.

| BELL AEROSPACE ACV TEST PLAN | TYPE LACV-30-1 | OPER. NO. A1- 0114 (1977) |
|---|---|---|

| ACV CREW | | NO CHASE AIRCRAFT | | TEST CONDITIONS | | |
|---|---|---|---|---|---|---|
| CREW POSITION | NAME | TYPE A/C | CREW | | TAKEOFF | LAND |
| Operator | D. Hall | | | WEIGHT | 76,000 | |
| Oper. Nav. | Msgt R. Layne | | | FUEL | As Noted | |
| Obs. | LT. R. Lindley | | | C.G. | 447 | |
| Obs. | G. Penn | INSTRUMENTATION PLAN OCTAVE BAND ANAL. | | BALLAST | None | |
| Obs./C.O.R. | G Sargent | SETUP NO. N/A | AMEND NO. N/A | ALT SETTING | 30.14 | |
| | | RADIO FREQ. | | PRESS ALT | S.L. | |
| TEST ENGINEER | C. Stauffer | URC-80 | VRC-46 | WIND | L/V | |
| TEST DIRECTOR | C. Stauffer | P | P | TEMP | 135F | |
| FINAL GO-NO GO AUTHORITY | C. Stauffer | S | S | Sea State | <1 | |

**CRAFT CHANGES SINCE LAST OPERATION**

1. Corrected Stbd Prop Control Hollow by replacing high pressure pump. Also change relief valve

Fuel Quantity

| | P | S |
|---|---|---|
| F | 5% | 12.5 |
| M | 35 | 35 |
| A | 42.5 | |

**TEST PURPOSE**

I. Water hover (15 minutes)
II. Speed runs (30-50 mph)
III. Cabin Noise Level (V max.)
IV. Maneuvering 8's (30-50 mph)
V. Safe Limits
VI. Engines failure/crash stop (30-50 mph)
VII. Engine failure/spinout (30-50 mph)

| TEST ENGINEER | OPER. IN COMMAND | APPROVAL |
|---|---|---|
| Chas. J. Stauffer | D. Hall | G. Sargent COR |

**TEST PROCEDURE**

Normal start, etc. in accordance with Procedures and Checklists. Proceed to a suitable water test site agreeable to the C.O.R.

NOTE: Sea states are critical for the demonstration; SS < 1 is optimum, SS < 2 is acceptable, SS < 3 is limiting.

Conduct Acceptance and Type Tests (Ref.: DAAK02-75-C-0149, Exhibit I, Pages 10 and 11).

I. Water hover per Attachment I (Ref. Item (9)(a)1)b) - Acceptance)
II. Speed runs per Attachment II (Ref. Items (9)(a)1)d) - Acceptance)
III. Cabin noise level per Att. III (Ref. Item (9)(a)5) - Type
IV. Maneuvering 8's per Att. IV (Ref. Item (9)(a)1)f) - Type
V. Safe limits per Att. V (Ref. Item (9)(a)1)a) - Type
VI. Crash stop per Att. VI (Ref. Item (9)(a)1)e) - Type
VII. Spin out per Att. VII (Ref. Item (9)(a)1)g) - Type

Engine Start 0900
Lift Off 0910
Depart Anzio 0912 (for Ft. Story)
Arrive Ft Story 1008 (41 Knots Average)

Local @ Ft Story To 1100

U.S. ARMY ACCEPTANCE

LACV-30-1

WATER HOVER WITHOUT LOAD

1. Record craft weight 80,000 lbs. 447 l.c.g.
2. In cushion mode, trim and perform a 15 minute hover demonstration into the wind.
3. Manually record the following data:

| | Start | | | | Complete | | | |
|---|---|---|---|---|---|---|---|---|
| Time | 0915 | | | | 0930 | | | |
| Sea State | <1 | | | | <1 | | | |
| Heading | 140 | | | | 135 | | | |
| Wind/Vel. | 4V | | | | 4V | | | |
| % Fuel (Fwd.) | 5 | 12.5 | | | 5 | 12.5 | | |
| (Main) | 35 | 35 | | | 32.5 | 32.5 | | |
| (Aft) | 42.5 | | | | 42.5 | | | |
| $N_2$ (%) | 95 | 95 | 95 | 95 | 95 | 95 | 96 | 95 |
| TOP (psig) | 22 | 24 | 24 | 23 | 23 | 25 | 24 | 23 |

COMMENTS:

Completed Chester L. Stauffer

Accepted [signature]
U.S.A. Representative

Verified CLS for
BAC Quality

U.S. ARMY ACCEPTANCE

LACV-30-1

OVERWATER SPEED RUNS

1. Proceed to the selected operating area.

2. Record environmental data off cushion.

| +3° | <1 | L/V | 76,000 |
|---|---|---|---|
| OAT (°C) | Sea State | W/V | G.W. (lbs.) |

3. Hover into the wind and trim as required.

4. Accelerate thru hump observing engine limits.

5. Continue acceleration to full speed (30 - 50 mph target) with ballast trim as required for maximum performance.

6. Record data at maximum speed ( 53 mph CAS).

| | | | | |
|---|---|---|---|---|
| $T_7$ (°C) | 580 | 595 | 590 | 575 |
| $N_1$ (%) | 99 | 100 | 100 | 100 |
| $N_2$ (%) | 95 | 95 | 95 | 95 |
| TOP (psi) | 52 | 51 | 52 | 52 |
| Limiting Parameter/Value | #2 EGT 595 | | | |

NOTE: Speed obtainable may be a function of Sea State and/or Gross Weight. Maximum permissable speeds, CAS (mph) = IAS - Wind Speed are: SS1 = 60, SS2 = 45, SS3 = 35.

7. If practicable, timed runs should be made in near calm water over a measured course. Upwind and downwind passes should be made if the head/tail wind component is greater than 5 mph. Record pertinent data below:

| W/V | Heading | Dist. | Time | Speed |
|---|---|---|---|---|
| L/V | 160 | 1 N.M. | 1.12 MIN | 53 K |
| | | | | |

7. Cont'd.

NOTE: If used, record craft data in Item 6.

8. COMMENTS:

DATA Taken by MSgT R. Laymance

Completed Charles L. Stauffer Accepted [signature]
U.S.A. Representative

Verified C.L.S. for
BAC Quality

U.S. ARMY ACCEPTANCE

LACV-30-1

CABIN NOISE LEVEL - FULL SPEED

1. Concurrent with Attachment A1-II, conduct a survey with engines at full power and craft at full speed. Obtain noise data at ear level.

2. Record reference data:

| | | | | |
|---|---|---|---|---|
| $T_7$ (°C) | 520 | 540 | 545 | 520 |
| $N_1$ (%) | 91 | 94 | 92 | 94 |
| $N_2$ (%) | 95 | 95 | 95 | 95 |
| TOP (psi) | 43 | 45 (cor.) | 43 | 43 |

| No. of Crew | SS | OAT (°C) | IAS (mph) |
|---|---|---|---|
| 5 | <1 | +1 | 42 |

3. Record Octave Band Analyzer data:

| Freq. (hz) | Operator A ~~Raw~~ | Operator B ~~Corr.~~ | Passenger A ~~Raw~~ | Passenger B ~~Corr.~~ |
|---|---|---|---|---|
| 16,000 | 61 | 66 | 62 | 68 |
| 8,000 | 63 | 69 | 60 | 65 |
| 4,000 | 66 | 71 | 68 | 71 |
| 2,000 | 75 | 81 | 77 | 83 |
| 1,000 | 82 | 88 | 83 | 89 |
| 500 | 84 | 89 | 85 | 90 |
| 250 | 91 | 94 | 93 | 99 |
| 125 | 94 | 99 | 96 | 101 |

NOTE: A is AT MAX. CONT. POWER (Normal)
B is AT MAX. POWER (5 minute limit

4. Record model and S/N of Test Equipment.

Octave Band Noise Analyzer
General Radio Corp Type 1558P S/N 732

5. Attach calibration sheets.

N/A

Completed Charles L. Stauffer Accepted [signature]
U.S.A. Representative

Verified C. L. Stauffer Jr
BAC Quality

U.S. ARMY ACCEPTANCE

LACV-30-1

MANEUVERING (8's) - OVER WATER

1. Proceed to the selected operations area.

   NOTE: If practicable, maneuvers should be made near buoys so that turning radii can be estimated. Alternately, distances can be measured by radar.

2. Demonstrate maneuvering by performing Figure 8's at two speeds (IAS) as determined in BAC tests to be safe in the existing sea and wind conditions (30 - 50 mph target entry).

3. Record data as follows:

| | Pattern 1 | Pattern 2 |
|---|---|---|
| Sea State | <1 | < |
| W/V | L/V | L/V |
| Radii (Up wind) | 1500 | 400 |
| (Down wind) | — | — |
| Method | Estimated (Radar, other) | |
| Average $N_2$ (%) | 95 | 90 |
| Maximum TOP (psi) | 46 | 42 |
| Entry Speed (IAS) | 40 | 30 |

4. Comments:

Completed [signature]

Accepted [signature]
U.S.A. Representative

Verified C. L. S[signature]
BAC Quality

U.S. ARMY ACCEPTANCE

LACV-30-1

SAFE OPERATING LIMITS (WATER)

1. Proceed to the selected operations area.

2. Based on BAC tests under similar water and wind conditions, demonstrate that the craft will not "Plow In" at selected speeds in straight and yawed conditions (over water).

3. Record the following data:

| | Yaw Angle = 0 | Yaw Angle = 30 (Enter) |
|---|---|---|
| Sea State | <1 | <1 |
| W/V | 4✓ | 4✓ |
| Av. $N_2$ (%) | 95 | 95 |
| Av. TOP (psi) | 48 | 48 |
| Entry Speed (IAS) | 45 | 45 |

4. Record any adverse behavior.

None

NOTE: "Plow In" is primarily encountered at high speeds over calm water where craft pitch trim is bow down. If requested and practicable, trim ballast may be moved forward to a condition proven safe in BAC tests for the foregoing demonstration.

5. Record fuel quantities (%) demonstrated:

| | | |
|---|---|---|
| Forward | 0 | 0 |
| Main | 12 | 15 |
| Aft | 30 | — |

6. Comments:

Completed Chick T. Stauffer Accepted [signature]
U.S.A. Representative

Verified C. S. Stauffer
BAC Quality

U.S. ARMY ACCEPTANCE

LACV-30-1

<u>ENGINES (2) FAILURE</u> - <u>"CRASH STOP"</u>

1. Proceed to the selected operations area.

2. Based on BAC tests under similar water and wind conditions, demonstrate the craft under simulated engines (2) failure conditions with optimum trim from a target speed of 30-50 mph.

3. Record pertinent data.

| | Yaw Angle = 0 | | Yaw Angle = 30 (Enter) | |
|---|---|---|---|---|
| Sea State | <1 | | <1 | |
| W/V | 4V | | 4V | |
| "Cut" IAS | 40 | | 45 | |
| Time to Stop | 9 | | 15 | |
| Entry $N_2$ (%) | 95 | Av. | 95 | Av. |
| Entry TOP (psi) | 44 | Av. | 48 | Av. |

4. Record craft behavior.

No adverse behavior

5. Record fuel quantities (%) demonstrated:

| | | |
|---|---|---|
| Forward | 0 | 0 |
| Main | 20 | 20 |
| Aft | 30 | — |

6. Comments:

Stop in 9 sec; estimated 50 yds.

Completed ______ Accepted ______
U.S.A. Representative

Verified ______
BAC Quality

U.S. ARMY ACCEPTANCE

LACV-30-1

ENGINE (1) FAILURE - "SPINOUT"

1. Proceed to the selected operations area.

2. Based on BAC tests under similar water and wind conditions, demonstrate the craft under simulated engine (1) failure conditions with optimum trim from a target speed of 30-50 mph. Selected engine to be cut is at operator's discretion; corrective action is allowable.

3. Record pertinent data:

| | Yaw Angle = 0 | | Yaw Angle = 30 (Enter) | |
|---|---|---|---|---|
| Sea State | <1 | | <1 | |
| W/V | 4V | | L/V | |
| "Cut" IAS | 40 | | 30 | |
| Entry $N_2$ (%) | 95 | Av. | 95 | Av. |
| Entry TOP (psi) | 48 | Av. | 44 | Av. |

4. Record corrective action.

Reduced power on opposite side

5. Record craft behavior.

Yaw in direction of cut, side lip until corrective action is taken. Estimate roll angle to failure ≈ 25°.

6. Record fuel quantities (%) demonstrated.

| | | |
|---|---|---|
| Forward | 0 | 0 |
| Main | 20 | 20 |
| Aft | 30 | |

7. Comments:

Completed [signature] Accepted [signature]
U.S.A. Representative

Verified [signature]
BAC Quality

| BELL AEROSPACE ACV TEST PLAN | TYPE LACV-30-1 | | OPER. NO. A2- 0113 (1977) | | | |
|---|---|---|---|---|---|---|
| **ACV CREW** | | NO CHASE AIRCRAFT | | **TEST CONDITIONS** | | |
| **CREW POSITION** | **NAME** | **TYPE A/C** | **CREW** | | **TAKEOFF** | **LAND** |
| Operator | D. Hall | | | WEIGHT | | |
| Oper. Nav. | R. Layman | | | FUEL | As Noted | |
| Obs/MERAD | LT. R. Lindberg | | | C.G. | See Loading Sheet | |
| Obs/TECOM | C. Penn | INSTRUMENTATION PLAN NONE | | BALLAST | STA 447 40,000 | |
| Obs./C.O.R. | J. Sargent | SETUP NO. N/A | AMEND NO. N/A | ALT SETTING | 30.09 | |
| | | RADIO FREQ. | | PRESS ALT | S.L. | |
| TEST ENGINEER | C. Stauffer | URC-80 | VRC-46 | WIND | 270/12 | |
| TEST DIRECTOR | C. Stauffer | P 16 | P | TEMP | +25°F | |
| FINAL GO-NO GO AUTHORITY | C. Stauffer | S 8 | S | Sea State | 1 | |

**CRAFT CHANGES SINCE LAST OPERATION**

Delivery Configuration Less:

1. EGT. Wiring, Stbd Power Module
2. Windshield Washer Inoperative
3. Port Nav. Light Out

| | | F | M | A |
|---|---|---|---|---|
| Fuel: | P | 20 | 62.5 | 42.5 |
| | S | 25 | 62.5 | |

**TEST PURPOSE**

I. Water hover with full load (115,000 lb. G.W.) for 15 minutes.

| TEST ENGINEER | OPER. IN COMMAND | APPROVAL |
|---|---|---|
| C. Stauffer | D. Hall | |

**TEST PROCEDURE**

Normal start, etc. in accordance with Procedures and Checklists. Proceed to a suitable water test site agreeable to C.O.R.

Conduct Acceptance Test (Ref: DAAK02-75-C-0149, Exhibit I, Page 11).

I. Water hover per Att. I (Ref. Item (9)(a)b).

Engine Start - 1140
Lift off - 1147 on 1/12/77

Notes: 1. P.S. 3+4 Flameout on rapid power reduction.
2. P.S. 4 repeated at shore departure. Restart prior
3. P.S. 4 No Ng Control

S/D 1218 To T/S P.S. 4.

L.O. - 1336 on 1/13/77

U.S. ARMY ACCEPTANCE

LACV-30-1

WATER HOVER WITH LOAD

1. Record craft weight 116,000 lbs. 445 l.c.g.
2. In cushion mode, trim and perform a 15 minute hover demonstration into the wind.
3. Manually record the following data:

| | Start | | | | Complete | | | |
|---|---|---|---|---|---|---|---|---|
| Time | 1350 | | | | 1405 | | | |
| Sea State | <1 | | | | <1 | | | |
| Heading | 330 | | | | 330 | | | |
| Wind/Vel. | 140/10 | | | | 140/10 | | | |
| % Fuel (Fwd.) | 20 | 25 | | | 10 | 10 | | |
| (Main) | 62.5 | 62.5 | | | 50 | 50 | | |
| (Aft) | 42.5 | | | | 70 | | | |
| $N_2$ (%) | 94 | 94 | 94 | 94 | 94 | 94 | 94 | 94 |
| TOP (psig) | 48 | 49 | 47 | 47 | 48 | 49 | 47 | 47 |

COMMENTS:

Also speed runs; average with Max Cont Power 33 mph. R. Lagman using radar Target distance/Time.

Completed C. L. Stauffer

Accepted [signature]
U.S.A. Representative

Verified C. L. Stauffer
BAC Quality

NOTE: May not be required since hover overland conducted at 115,000 G.W.

TABLE 4.3 LACV-30-2 AT BAT

THIS TABLE CONSISTS OF A SERIES OF TEST PLANS FOLLOWED BY TEST DATA.

| BELL AEROSPACE ACV TEST PLAN | TYPE LACV-30-2 | OPER. NO. A1-0409 |
|---|---|---|

| ACV CREW | | NO CHASE AIRCRAFT | | TEST CONDITIONS | | |
|---|---|---|---|---|---|---|
| CREW POSITION | NAME | TYPE A/C | CREW | | TAKEOFF | LAND |
| Operator | D. Hall | | | WEIGHT | Loading 006-2 | |
| Co-Operator | G. Yaeger | | | FUEL | (attached) | |
| U.S.A. Obs. | J. Sargent | | | C.G. | | |
| | | INSTRUMENTATION PLAN #1 | | BALLAST | | |
| | | SETUP NO. | AMEND NO. | ALT SETTING | | |
| | | RADIO FREQ. | | PRESS ALT | | |
| TEST ENGINEER | C. Stauffer | UHF | 121.7 | WIND | | |
| TEST DIRECTOR | " | UHF-FM | 6 | TEMP | | |
| FINAL GO-NO GO AUTHORITY | " | VHF-FM | TBD | | | |

CRAFT CHANGES SINCE LAST OPERATION

TEST PURPOSE

A. Demonstration to U.S. Army for acceptance:

1. Hover with full load.
2. System run-in tests
3. Cabin noise level (stationary)

| TEST ENGINEER | OPER. IN COMMAND | APPROVAL |
|---|---|---|
| C. Stauffer | D. Hall | John J. Sargent |

TEST PROCEDURE

I. Position craft on BAC concrete ramp north of production hangar. Restrain as required for wind and slope.

II. Perform Operator Inspection IAW Checklist.

III. Perform normal pre-start, start, etc. IAW Checklists.

IV. Raise craft in hover mode.

A. Conduct acceptance tests (DAAK02-75-C-0149, Attachment 1, Pages 10 and 11).

1. Hover with full load per Attachment I (Ref. Item 9(A)2)A.
2. Perform system run-in tests per Attachment 2 (Ref. Item 9(A)3)A & B.
3. Obtain cabin noise level data per Attachment 3 (Ref. Item 9(A)5).

U.S. ARMY ACCEPTANCE

LACV-30-2

<u>LAND HOVER WITH LOAD</u>

1. Verify craft configured per Loading.

2. In mushion mode, trim and perform a 15 minute demonstration at $N_2$ maximum (91% $N_2$ minimum).

3. Manually record the following data:

| | START | | | | COMPLETE | | | |
|---|---|---|---|---|---|---|---|---|
| Time | 1440 | | | | 1455 | | | |
| Fuel (FWD) | P 60 | | S 63 | | | | | |
| (Main) | 60 | | 65 | | SAME | | | |
| (Aft) | 25 | | | | | | | |
| $T_7$ (°C) | 570 | 540 | 480 | 460 | | | | |
| $N_1$ (%) | 93.0 | 93.5 | 89.5 | 88.5 | | | | |
| $N_2$ (%) | 91 | 91 | 91 | 91.5 | | | | |
| Torque (psi) | 27 | 27 | 20 | 20 | | | | |

COMMENTS:

COMPLETED G F Jaeger
BAC

ACCEPTED J Dargo
U.S.A. REPRESENTATIVE

VERIFIED Fred Mueller 4/9/76
BAC QUALITY

U.S. ARMY ACCEPTANCE

LACV-30-2

SYSTEM RUN-IN TESTS

1. Starting concurrent with Hover (Attachment 1) and continuing off cushion for a total of one hour, functionally operate the following systems:

Start Time 1445 Complete Time 1545

| | BAC | U.S.A. |
|---|---|---|
| Puff Ports (20 cycles each) | YES | S |
| Cabin Heaters (Both, Lo and Hi) | YES | |
| Windshield Heat (Continuous) | YES | |
| Air Conditioner (Vent & Cool) | YES | |
| APU (Generator On) | YES | |
| AN/URC-80 (4 Contacts) | YES | |
| AN/URC-46 (4 Contacts) | NO | |
| AN/PRC-94 (4 Contacts) | YES | |
| RMHS System (Continuous) | YES | |
| AN/ASN-43 Compass (Continuous) | NO | |
| Radar (Continuous) | YES | |
| Fuel Trim (To/From Transfers) | YES | |
| Engines (Continuous) | YES | |
| Propellers (As Required) | YES | |
| Windshield Wipers (4 Cycles) | YES | |
| Spotlight (4 Cycles) | YES | |
| Running Lights (Continuous) | YES | |
| Horn (4 Blasts) | YES | |

DISCREPANCIES AND DISPOSITION:

COMPLETED G.E. Yeager
BAC

ACCEPTED
U.S.A. REPRESENTATIVE

VERIFIED Fred Mueller 4/9/76
BAC QUALITY

U.S. ARMY ACCEPTANCE

LACV-30-2

CABIN NOISE LEVEL - STATIONARY

1. Concurrent with Attachment 1, conduct survey with engines at full power ($N_2$ maximum). Using an Octive-Bad Noise Analyzer, record noise levels at ear level.

| | Operator | | Freq. | Passenger | |
|---|---|---|---|---|---|
| | (Raw) | (Corr.) | (Hertz) | (Raw) | (Corr.) |
| Band 1 | 0 | | ]6000 | 0 | |
| 2 | 58 | | 8000 | 58 | |
| 3 | 64 | | 4000 | 64 | |
| 4 | 66 | | 2000 | 68 | |
| 5 | 74 | | 1000 | 78 | |
| 6 | 84 | | 500 | 88 | |
| 7 | 98 | | 250 | 98 | |
| 8 | 102 | | 125 | 106 | |

Record engine parameters.

| | | | | |
|---|---|---|---|---|
| $N_1$ (%) | 93.0 | 93.5 | 89.5 | 88.5 |
| $N_2$ (%) | 91.0 | 91.0 | 91.0 | 91.5 |
| Torque (psi) | 27 | 27 | 20 | 20 |
| Prop. Pitch | 0 | | 0 | |

Record Model and Serial No. of Test Equipment.

General Radio Model 1558AP Octave Band Noise Analyzer, S/N 732.

Attach Calibration Sheets.

COMPLETED G.W. Yaeger (signature) BAC    ACCEPTED (signature) U.S.A. REPRESENTATIVE

VERIFIED Fred Mueller 4/9/76 BAC QUALITY

## LACV-30 #2, VOYAGEUR #006

## 2ND TEST WEIGHT AND BALANCE

| | Weight | Longitudinal Arm | Moment |
|---|---|---|---|
| Basic Weight LACV-30 #2 Voyageur #006 From LACV-30 #1 Actual Weight | 51859 | 488.4 | 25328000 |
| Test Instrumentation | (536) | | (322906) |
| Instr. Package Install. Craft Attitude | 34 | 439.5 | 14943 |
| Instr. Package Install. Data Acquisition | 484 | 613.8 | 297079 |
| Flex. Conduit for above | 10 | 690.0 | 6900 |
| Control Install. Cabin Data Acquisition | 8 | 498.0 | 3984 |
| Revised Basic Weight | 52395 | 489.6 | 25650906 |
| Load Spreaders - Fwd | 1106 | 299 | 330694 |
| Load Spreaders - Aft | 958 | 483 | 462714 |
| Lashings - MILVAN - Fwd | 428 | 390 | 166920 |
| Tee Hooks | 152 | 658 | 100016 |
| Sub-Total Weight | 55039 | 485.3 | 26711250 |
| Crew | 360 | 653 | 235080 |
| Passengers | 360 | 716 | 257760 |
| Unusable Fuel | 650 | 397.5 | 258375 |
| Carbo - MILVAN #3610 | 4745 | 390 | 1850550 |
| - Ballast | 14331 | 390 | 5589090 |
| Operating Weight | 75485 | 462.4 | 34902105 |
| Fuel - Fwd 73% (5103) | 3748 | 100.5 | 376674 |
| - Main 85% (14755) | 12543 | 397.5 | 4985843 |
| - Aft 12% (4849) | 590 | 810.5 | 478195 |
| Gross Weight | 92366 | 441.1 | 40742817 |

| BELL AEROSPACE ACV TEST PLAN | TYPE LACV-30-2 | OPER. NO. A2-0409 |
|---|---|---|

| ACV CREW | | CHASE AIRCRAFT NO | | TEST CONDITIONS | | |
|---|---|---|---|---|---|---|
| CREW POSITION | NAME | TYPE A/C | CREW | | TAKEOFF | LAND |
| Operator | Hall | | | WEIGHT | Loading 006-2 | |
| Co-Operator | Yaeger | | | FUEL | (Attached) | |
| U.S.A. Obs. | | | | C.G. | | |
| | | INSTRUMENTATION PLAN #1 | | BALLAST | | |
| | | SETUP NO. | AMEND NO. | ALT SETTING | | |
| | | RADIO FREQ. | | PRESS ALT | | |
| TEST ENGINEER | Stauffer | VHF | 121.7 | WIND | | |
| TEST DIRECTOR | " | VHF-FM | P 55.85<br>S 85.55 | TEMP | | |
| FINAL GO-NO GO AUTHORITY | " | UHF-FM | 6 | | | |

**CRAFT CHANGES SINCE LAST OPERATION**

**TEST PURPOSE**

A. Demonstration to U.S. Army for acceptance:

1. Hover with no load.
2. Speed Run (25 - 35 mph)

| TEST ENGINEER | OPER. IN COMMAND | APPROVAL |
|---|---|---|
| C Stauffer | D Hall | John B Sargent |

**TEST PROCEDURE**

I. Position craft on BAC concrete ramp north of Production Hangar. Restrain as required for wind and slope.

II. Perform Operator Inspection IAW Checklist.

III. Perform normal pre-start, start, etc. IAW Checklists.

IV. Operate craft and systems as required:

A. Conduct acceptance tests (DAAK02-75-C-0149, Attachment I, Page 11):

1. Hover without load per Attachment 1 (Ref. Item (9)(a)2)a).
2. Perform speed runs per Attachment 2 (Ref. Item (9)(a)2)b).

V. Return to BAC Ramp and secure craft.

U.S. ARMY ACCEPTANCE

LACV-30-2

OVERLAND HOVER WITHOUT LOAD

1. Verify craft configured per loading.
2. In cushion mode, trim and perform a 15 minute demonstration at $N_2$ maximum (91% $N_2$ minimum).
3. Manually record the following data:

| | START | COMPLETE |
|---|---|---|
| Time | | |
| Fuel (Fwd) | | |
| (Main) | SEE A1 | |
| (Aft) | | |
| T7 (°C) | | |
| $N_1$ (%) | | |
| $N_2$ (%) | | |
| Q (psi) | | |

COMMENTS: Mr. Sargent was satisfied with previous results; therefore repeat of test was not necessary.
C. F. Stoller
4/9/76

COMPLETED [signature]
BAC

ACCEPTED [signature]
U.S.A. REPRESENTATIVE

VERIFIED [signature] 4/9/76
QUALITY

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U.S. ARMY ACCEPTANCE

LACV-30-2

OVERLAND SPEED RUNS (25 TO 35 mph)

1. Determine wind direction in the Test Area.

2. Record Wind Direction 345, Velocity 10 mph.

3. On wind dependent course selected, perform two reciprocal runs at speed from 25 to 35 mph (estimated).

4. Record IAS, ground speeds attained and measurement method (pacer, time/dist., other).

| | IAS (mph) | GS (mph) | Method (TIME/DIST) |
|---|---|---|---|
| Run 1 | 35 | 30 | SCALED EAST TO WEST |
| Run 2 | 55 | 42 | SCALED WEST TO EAST |
| Average | 45 | 36 | SCALED (AVERAGE) |

5. COMMENTS:

COMPLETED G.K. Jaeger
BAC

ACCEPTED [signature]
U.S.A. REPRESENTATIVE

VERIFIED Fred Mueller 4/9/76
BAC QUALITY

TABLE 4.4. LACV-30-2 AT APG

THIS TABLE CONSISTS OF A SERIES OF TEST PLANS FOLLOWED BY TEST DATA.

| BELL AEROSPACE ACV TEST PLAN | TYPE LACV-30-2 | OPER. NO. A1-0914 |
|---|---|---|

| ACV CREW | | NO CHASE AIRCRAFT | | TEST CONDITIONS | | |
|---|---|---|---|---|---|---|
| CREW POSITION | NAME | TYPE A/C | CREW | | TAKEOFF | LAND |
| Operator | D. Hall | | | WEIGHT | 75,000# | 73,000 |
| Oper. Nav. | C Stauffer | | | FUEL | See A1-1 | |
| Obs 1 | Capt Peoples | | | C.G. | 433 | |
| Obs 2 | F Mueller | INSTRUMENTATION PLAN APG | | BALLAST | As Required | |
| Obs./C.O.R. | J. Sargent | SETUP NO. — | AMEND NO. — | ALT SETTING | 0 | |
| | Outside | RADIO FREQ. | | ~~PRESS ALT~~ BAR | 30.34" hg | |
| TEST ENGINEER | C. Stauffer | URC-80 | VRC-46 | WIND | 180/2 | |
| TEST DIRECTOR | C. Stauffer | P | P | TEMP | 30.4°C | 31.0°C |
| FINAL GO-NO GO AUTHORITY | C. Stauffer | S | S | Sea State | Calm | |

**CRAFT CHANGES SINCE LAST OPERATION**

AMS Complete
Two Mirrors

**TEST PURPOSE**

I. Water hover (15 minutes)
II. Speed runs (30-50 mph)
III. Obstacles (wall & ditch)
IV. Net Thrust Measurements
V. Air Conditioning Functional Test

| TEST ENGINEER | OPER. IN COMMAND | APPROVAL |
|---|---|---|
| C. S. Stauffer | Doug Hall | C. Brown J. Sargent |

**TEST PROCEDURE**

Normal start, etc. in accordance with Procedures and Checklists. Proceed to a suitable water test site agreeable to the C.O.R.

NOTE: Sea states are critical for the demonstration; SS < 1 is optimum, SS < 2 is acceptable, SS < 3 is limiting.

Conduct Acceptance and Type Tests (Ref.: DAAK02-75-C-0149, Exhibit I, Pages 10 and 11).

I. Water hover per Attachment I (Ref. Item (9)(a)1)b) - Acceptance)

II. Speed runs per Attachment II (Ref. Items (9)(a)1)d) - Acceptance)

III. Obstacles per Attachment III (Ref. Item (9)(a)2)d) - Type)

IV. Net thrust per Attachment IV (Ref. Item (9)(a)1)c) - Type)

V. Air conditioning per Attachment V (Ref. Item (9)(b)7) - Acceptance)

**U.S. ARMY ACCEPTANCE**

LACV-30-2

# WATER HOVER WITHOUT LOAD

1. Record craft weight 75,000 lbs. 433 l.c.g.
2. In cushion mode, trim and perform a 15 minute hover demonstration into the wind.
3. Manually record the following data:

| | Start | | | | Complete | | | |
|---|---|---|---|---|---|---|---|---|
| Time | 1450 | | | | 1510 | | | |
| Sea State | Calm | | | | Calm | | | |
| Heading | 115 | | | | 120 | | | |
| Wind/Vel. | L/V | | | | L/V | | | |
| % Fuel (Fwd.) | 85 | 85 | | | 85 | 85 | | |
| (Main) | 30 | 25 | | | 30 | 25 | | |
| (Aft) | 0 | | | | 0 | | | |
| $N_2$ (%) | 82 | 81 | 82 | 82 | 82 | 82 | 81 | 82 |
| TOP (psig) | 14 | 16 | 14 | 16 | 15 | 16 | 15 | 16 |

COMMENTS:

None

Completed C. L. Stauffer

Verified Fred Mueller
BAC Quality

Accepted John B. Sargent
U.S.A. Representative

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LACV-30-2

OVERWATER SPEED RUNS

1. Proceed to the selected operating area.

2. Record environmental data off cushion.

| 30.4 | Calm | 180/12 | 25,000 |
|---|---|---|---|
| OAT (°C) | Sea State | W/V | G.W. (lbs.) |

3. Hover into the wind and trim as required.

4. Accelerate thru hump observing engine limits. 34 sec.

5. Continue acceleration to full speed (30 - 50 mph target).with ballast trim as required for maximum performance.

6. Record data at maximum speed ( 45 mph CAS). 42 mph N
45 mph Plow

| | | | | |
|---|---|---|---|---|
| $T_7$ (°C) | 590 | 586 | 600 | 580 |
| $N_1$ (%) | 98 | 99.5 | 95 | 95.5 |
| $N_2$ (%) | 90 | 90 | 90 | 90 |
| TOP (psi) | 40 | 42 | 36 | 36 |

Limiting Parameter/Value Trim Attitude

NOTE: Speed obtainable may be a function of Sea State and/or Gross Weight. Maximum permissable speeds, CAS (mph) = IAS - Wind Speed are: SS1 = 60, SS2 = 45, SS3 = 35.

7. If practicable, timed runs should be made in near calm water over a measured course. Upwind and downwind passes should be made if the head/tail wind component is greater than 5 mph. Record pertinent data below:

| W/V | Heading | Dist. | Time | Speed |
|---|---|---|---|---|
| L/V | 245 | 2 n.m. | 3.2 | 38K (44 mph) |
| L/V | 060 | 2 n.m | 3.4 | 35.5 (41 mph) |

7. Cont'd.

NOTE: If used, record craft data in Item 6.

8. COMMENTS:

1. Item 7, 2nd run had gentle plow-in prior to completion.

2. Speed runs were not at maximum power due to uncompensated $T_7$ limits.

Completed C. L. Stauffer

Verified Fred Mueller
BAC Quality

Accepted John F. Sargent
U.S.A. Representative

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US ARMY ACCEPTANCE
LACV-30-2

## OBSTACLES

1. Record craft weight 78,000 lbs and 438.0 l.c.g.

2. With $N_2$ at maximum and power as required, negotiate a ditch (approximately 6 ft wide by 9 ft deep) and vertical obstacle (3 ft maximum height).

3. Manually record the following data:

| | DITCH | | | | STEP | | | |
|---|---|---|---|---|---|---|---|---|
| TIME | 9/14/76 1530 | | | | 9/15/76 1045 | | | |
| HEADING | 180 | | | | 3[illegible] | | | |
| WIND/VEL | 1/V | | | | 09/[illegible] | | | |
| $N_1$ (%) | 98 | 98 | 98 | 98 | 99 | 99 | 100 | 100 |
| $N_2$ (%) | 90 | 90 | 90 | 90 | 96 | 95 | 95 | 95 |
| $T_7$ (°C) | 600 | 600 | 630 | 600 | 630 | 630 | 630 | 630 |
| TOP (psig) | 42 | 42 | 41 | 40 | 48 | 48 | 48 | 48 |

COMMENTS:

IAS 22 mph
Engine Readings
Are Approximate

IAS 33 mph
Engine Readings
Are Approximate

COMPLETED Chuck S. Senff

ACCEPTED John J. Sargent
US Army Representative

VERIFIED Fred Mueller
BAT QUALITY

Note: Measured 10 foot wide ditch at crossing point.

Total Time for 2 operations = 1.0 hrs.

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US ARMY ACCEPTANCE
LACV-30-2

NET THRUST MEASUREMENT

1. Record craft weight ___78,600___ lbs and ___440___ l.c.g.

2. On water, tether the craft to a government furnished thrust measuring device using a bridle attached to bow (and stern) tow fittings.

3. At target shaft speeds ($N_2$) of 60 and 95%, measure reverse and forward thrust. Record data in attached sheet (Test Nos. A thru D).

COMMENTS:

Due to inability to maintain craft normal to tether point, the values obtained are not considered to be the maximum possible. Test will be repeated over land o/a 9/[illegible]/76

COMPLETED [illegible]

VERIFIED Fred Mueller
BAT QUALITY

ACCEPTED John B. Sargent
US Army Representative

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9/13/76

| TEST DATA RECORDING LOG | OPERATION NO. | A1-IV | SHT 2 OF 2 |
|---|---|---|---|

| TEST NO. | INST | POWER PLANT 1 | POWER PLANT 2 | POWER PLANT 3 | POWER PLANT 4 | REMARKS |
|---|---|---|---|---|---|---|
| A | T7 | | | | | Reverse thrust off cushion |
| | N1 | | | | | Target = 60% |
| | N2 | | | | | Measured thrust = 540 lbs |
| | TOP | | | | | |
| | PP | -23.5 | | -23.5 | | |
| | W/V | | ASI RDG | | HEADING | |
| | | | | | | |
| B | T7 | | | | | Reverse thrust on cushion |
| | N1 | | | | | Target = 95% |
| | N2 | | | | | Measured thrust = [illegible] lbs |
| | TOP | | | | | |
| | PP | -23.5 | | -23.5 | | |
| | W/V | | ASI RDG | | HEADING | |
| | | | | | | |
| C | T7 | | | | | Forward thrust off cushion |
| | N1 | | | | | Target = 60% |
| | N2 | | | | | Measured thrust = 2300 lbs |
| | TOP | | | | | |
| | PP | +23.5 | | +23.5 | | |
| | W/V | | ASI RDG | | HEADING | |
| | | | | | | |
| D | T7 | | | | | Forward thrust on cushion |
| | N1 | | | | | Target = 95% |
| | N2 | | | | | Measure thrust = 3700 lbs |
| | TOP | | | | | |
| | PP | +23.5 | | +23.5 | | |
| | W/V | | ASI RDG | | HEADING | |
| | | | | | | |
| | T7 | | | | | W/V 150/2 Hdg 230 START / STOP |
| | N1 | | | | | TIME 1115 / 1210 |
| | N2 | | | | | TEMPERATURE 15.6°C / 16.0° |
| | TOP | | | | | BAROMETER 30.13 / 30.13 |
| | PP | | | | | |
| | W/V | | ASI RDG | | HEADING | SEA STATE Calm / Calm |
| | | | | | | |

US ARMY ACCEPTANCE
LACV-30-2

AIR CONDITIONER PERFORMANCE

1. In conjunction with any previous tests, determine the performance of the air conditioner (Target: 85°F maximum effective temperature at outside temperature of 125°F).

2. Manually record the following data (30 minute period):

| | START | STOP |
|---|---|---|
| TIME (AIR CONDITIONER) | 1425 | 1455 |
| OUTSIDE AIR TEMPERATURE | 101F° | 101°F |
| CABIN TEMPERATURE: | | |
| LEFT FRONT | 101 | 78 |
| RIGHT FRONT | 101 | 78 |
| LEFT REAR | 101 | 78 |
| RIGHT REAR | 101 | 78 |
| AVERAGE | 101 | 78 |

COMMENTS:

Thermometer in Air Conditioner cooled in 10 minutes to 42°F.

COMPLETED Chuck L. Staff ACCEPTED John B. Sargent
US Army Representative

VERIFIED Fred Mueller
B.A.T. QUALITY

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| BELL AEROSPACE ACV TEST PLAN | | TYPE LACV-30-2 | | OPER. NO. S - 0916 | | |
|---|---|---|---|---|---|---|
| **ACV CREW** | | **CHASE AIRCRAFT** | | **TEST CONDITIONS** | | |
| CREW POSITION | NAME | TYPE A/C | CREW | | TAKEOFF | LAND |
| Operator | D. Hall | | | WEIGHT | N/A | |
| | | | | FUEL | | |
| | | | | C.G. | | |
| | | INSTRUMENTATION PLAN APG | | BALLAST | | |
| | | SETUP NO. A | AMEND NO. 2 | ALT SETTING | | |
| | | RADIO FREQ. | | PRESS ALT | | |
| TEST ENGINEER | C. Bardak | N/A | | WIND | | |
| TEST DIRECTOR | C. Bardak | | | TEMP | | |
| FINAL GO-NO GO AUTHORITY | C. Stauffer | | | | | |

CRAFT CHANGES SINCE LAST OPERATION

1. Loaded MILVANS replaced with Empty
2. Instrumentation patched as noted

NOTE: Exhaust Collectors not installed

TEST PURPOSE

1. Overland Thrust measurement
2. Partial Propeller Gearbox Vibration Survey
3. Exhaust Collector Vibration Survey

| TEST ENGINEER | OPER. IN COMMAND | APPROVAL |
|---|---|---|
| | | C. L. Stauffer |

TEST PROCEDURE

A. Tether craft at stern to GFE Thrust measurement fan. Attach bridle on STBD side to restrain lateral movement

B. Perform normal pre-operational, start, etc. procedures

C. With Prop Control set for 0 effective Thrust, step up $N_2$ from minimum to maximum in 2-3% increments. Voice annotate magnetic tape.

D. Set $N_2$ at 95%. Advance $\beta$ for TOP sets of approximately 5% to limit conditions. Manually record data on attached sheets.

E. At MAP, reduce $N_2$ in 2-3% increments to minimum. Voice annotate magnetic tape.

F. Secure operations. Record ambient data.

| TEST DATA RECORDING LOG | OPERATION NO. 5-0916 | SHT 1 OF 2 |
|---|---|---|

| TEST NO. | INST | POWER PLANT 1 | 2 | 3 | 4 | REMARKS |
|---|---|---|---|---|---|---|
| | | | | | | All with $N_2 \simeq 95\%$ |
| | T7 | 510 | 490 | 500 | 490 | |
| | N1 | 87.8 | 90 | 87.5 | 87.2 | |
| | N2 | 95.5 | 95.2 | 95.5 | 95.2 | |
| | TOP | 22 | 23 | 22 | 22 | |
| | PP | $\simeq$ ~ 3.5° | | | | Set 0 Effective Thrust |
| | W/V | | ASI RDG | | HEADING | |
| | | | | | | |
| | T7 | 510 | 520 | 520 | 510 | |
| | N1 | 90.5 | 91.5 | 89 | 89.2 | |
| | N2 | 95 | 94.5 | 95 | 94.8 | |
| | TOP | 25 | 26 | 25 | 25 | Target 25% TOP |
| | PP | As | | Rad | | |
| | W/V | | ASI RDG | | HEADING | |
| | | | | | | |
| | T7 | 530 | 520 | 550 | 530 | |
| | N1 | 92.3 | 93.7 | 91.2 | 91.4 | |
| | N2 | 94.3 | 94 | 94.3 | 94 | |
| | TOP | 30 | 30 | 30 | 30 | Target 30% TOP |
| | PP | As | | Rad | | |
| | W/V | | ASI RDG | | HEADING | |
| | | | | | | |
| | T7 | 550 | 540 | 570 | 560 | |
| | N1 | 94.8 | 96 | 93.4 | 93.4 | |
| | N2 | 93.5 | 93.2 | 93.7 | 93.3 | |
| | TOP | 35 | 36 | 35 | 35 | Target 35% TOP |
| | PP | As | | Rad | | |
| | W/V | | ASI RDG | | HEADING | |
| | | | | | | |
| | T7 | 570 | 550 | 600 | 580 | |
| | N1 | 96 | 97 | 96 | 96 | |
| | N2 | 93 | 94.4 | 95 | 93.5 | |
| | TOP | 40 | 40 | 40 | 40 | Target 40% TOP. |
| | PP | As | | Rad | | |
| | W/V | | ASI RDG | | HEADING | |
| | | | | | | |

| TEST DATA RECORDING LOG | OPERATION NO. | | SHT ___ OF ___ |
|---|---|---|---|

8500

| TEST NO. | INST | POWER PLANT 1 | 2 | 3 | 4 | REMARKS |
|---|---|---|---|---|---|---|
| | T7 | 600 | 580 | 640 | 610 | |
| | N1 | 98.5 | 99.8 | 98.5 | 98.5 | |
| | N2 | 92.3 | 92 | 92 | 91.7 | |
| | TOP | 45 | 46 | 45 | 46 | Target 45% TOP |
| | PP | As Req'd | | | | |
| | W/V | | ASI RDG | | HEADING | |
| | | | | | | |
| | T7 | 625 | 610 | 640 | 640 | To limit power conditions |
| | N1 | 100 | 101.5 | 78.5 | 99 | |
| | N2 | 81 | 80 | 78.5 | 77.5 | |
| | TOP | 53.5 | 53.5 | 53.5 | 53.5 | |
| | PP | + 23.5 | | + 23.5 | | |
| | W/V | | ASI RDG | | HEADING | β measured on Shutdown |
| | | | | | | |
| | T7 | | | | | As Req. |
| | N1 | | | | | |
| | N2 | | | | | |
| | TOP | | | | | |
| | PP | | | | | |
| | W/V | | ASI RDG | | HEADING | |
| | | | | | | |
| | T7 | | | | | |
| | N1 | | | | | |
| | N2 | | | | | |
| | TOP | | | | | |
| | PP | | | | | |
| | W/V | | ASI RDG | | HEADING | |
| | | | | | | |
| | T7 | | | | | |
| | N1 | | | | | |
| | N2 | | | | | |
| | TOP | | | | | |
| | PP | | | | | |
| | W/V | | ASI RDG | | HEADING | |
| | | | | | | |

CAL. (from Negative)
0 = −0.037V
4 = +2.07V = 10880 lb = 5183.7 lb/volt
3 = +1.03 = 5450 lb = 5107 } Avg 5135.2 lb/volt

# TEST DATA
(SOP MP 70-6)

DATE: 16.8.76

SHEET NO. ______

LACV-30 TOWARD PULL
ON LAND

| | TORQUE | TIME | | VOLTS | PULL lb | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |
| | 25 PSI | 1355 | | 0.445 | 2480 | | | | |
| | | | | 0.465 | 2580 | | | | |
| | | | | .465 | 2530 | | | | |
| | 30 PSI | | | 0.677 | 3670 | | | | |
| | | | | 0.685 | 3710 | | | | |
| | | | | .663 | 3600 | | | | |
| | 35 PSI | | | .860 | 4610 | | | | |
| | | | | .847 | 4540 | | | | |
| | | | | .863 | 4630 | | | | |
| | 40 PSI | 1400 | | 1.00 | 5330 | | | | |
| | | | | 1.02 | 5430 | | | | |
| | | | | | | | | | |
| | 45 PSI | | | 1.12 | 5940 | | | | |
| | | | | 1.13 | 6000 | | | | |
| | | | | 1.14 | 6040 | | | | |
| | | | | | | | | | |
| | MAX | REGS | | 1.15 | 6100 | | | | |
| | | ↓ | | 1.18 | 6250 | | | | |
| | | | | | 6330 | MAX ON OSCILLOGRAM | | | |
| | MAX | POWER | | 1.04 | 5530 | | | | |

STEAP-MT FORM 247, 1 May 74 (Edition of 29 Aug 69 may be used.)

| BELL AEROSPACE ACV TEST PLAN | TYPE LACV-30-2 | OPER. NO. A2- |
|---|---|---|

| ACV CREW | | NO CHASE AIRCRAFT | | TEST CONDITIONS | | |
|---|---|---|---|---|---|---|
| CREW POSITION | NAME | TYPE A/C | CREW | | TAKEOFF | LAND |
| Operator | D. Hall | | | WEIGHT | 115,000 | |
| Oper. Nav. | | | | FUEL A 100 | F 78 M 54 | F 78 M 54 |
| | | | | C.G. | 439.5 | |
| | | INSTRUMENTATION PLAN APG | | BALLAST | 50,000 Milvan STA 273 + 457 | |
| | | SETUP NO. | AMEND NO. | ALT SETTING | 0 | |
| Obs./C.O.R. | | | | | | |
| | | RADIO FREQ. | | PRESS ALT BA.O | 30.16" hg | |
| TEST ENGINEER | C. Stauffer | URC-80 | VRC-46 | WIND | 030/4 | |
| TEST DIRECTOR | C. Stauffer | P | P | TEMP | 23.7°C | |
| FINAL GO-NO GO AUTHORITY | C. Stauffer | S | S | Sea State | <1' | |

**CRAFT CHANGES SINCE LAST OPERATION**

**TEST PURPOSE**

I. Water hover with full load (115,000 lb. G.W.) for 15 minutes.

| TEST ENGINEER | OPER. IN COMMAND | APPROVAL |
|---|---|---|
| C. L. Stauffer | Doug Hall | G. E. Brown; John 3. Sargent |

**TEST PROCEDURE**

Normal start, etc. in accordance with Procedures and Checklists. Proceed to a suitable water test site agreeable to C.O.R.

Conduct Acceptance Test (Ref: DAAK02-75-C-0149, Exhibit I, Page 11).

I. Water hover per Att. I (Ref. Item (9)(a)b).

**NOTE:** Open items from Test A1 may be added by reference to this operation.

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U.S. ARMY ACCEPTANCE

LACV-30-1

WATER HOVER WITH LOAD

1. Record craft weight 115,000 lbs. 439.5 l.c.g.
2. In cushion mode, trim and perform a 15 minute hover demonstration into the wind.
3. Manually record the following data:

| | Start | | Complete | |
|---|---|---|---|---|
| Time | [illegible] | | 1606 | |
| Sea State | <1 | | <1 | |
| Heading | 292 | | 292 | |
| Wind/Vel. | 030/4 | | 030/4 | |
| % Fuel (Fwd.) | 40 | 40 | 40 | 40 |
| (Main) | 60 | 60 | 60 | 47 |
| (Aft) | 97 | | 90 | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| $N_2$ (%) | 93 | 93 | 90 | 93 | [illegible] | [illegible] | [illegible] | 86 |
| TOP (psig) | 42 | 42 | 42 | 42 | 17 | 16 | 18 | 16 |
| | RUN | | | | HOVER | | | |

COMMENTS:

overwater @ [illegible]
600°C 101 $N_1$, 98% $N_2$, 42 TOP IAS [illegible] mph [illegible] water
WATER 40' [illegible]
Time run 1 mile 1:47 sec = 19.2 mph

Completed ______________

Accepted ______________
U.S.A. Representative

Verified ______________
BAC Quality

## TABLE 4.5 - THRUST LOADING

| Condition | $H.P._{TOT}$ | $H.P._L$ | $H.P._p$ | $C_p$ | Net Force/Prop Lbs. | Aero Drag Lbs. | Mom. Drag | Thrust Lbs. | $C_T$ | $C_{T_{Pred.}}$ | % Pred. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Hover Test Point | | | | | | | | | | | |
| 1 | 734 | 547 | 184 | 0.0206 | 0 | 19.9 | 45.4 | 32.7 | 0.0020 | NA | - |
| 2 | 828 | 536 | 286 | 0.0325 | 1265 | | 44.9 | 1297.4 | 0.0796 | NA | - |
| 3 | 972 | 513 | 445 | 0.0527 | 1830 | | 43.9 | 1861.9 | 0.1172 | NA | - |
| 4 | 1139 | 509 | 617 | 0.0736 | 2295 | | 43.7 | 2326.8 | 0.1470 | 0.166 | 88.6 |
| 5 | 1285 | 497 | 771 | 0.0937 | 2688 | | 43.1 | 2719.5 | 0.1742 | 0.1962 | 88.8 |
| 6 | 1448 | 481 | 948 | 0.1154 | 2997 | | 42.4 | 3028.1 | 0.1974 | 0.226 | 87.3 |
| 7 | 1467 | 297 | 1148 | 0.224 | 3113 | 19.9 | 32.2 | 3139.0 | 0.2758 | 0.287 | 96.1 |

$H.P._L$ Calculated

$H.P._p = 0.98\ (H.P._{TOT} - H.P._L)$ $\eta_p = 0.98$ Used in all predicted calculations

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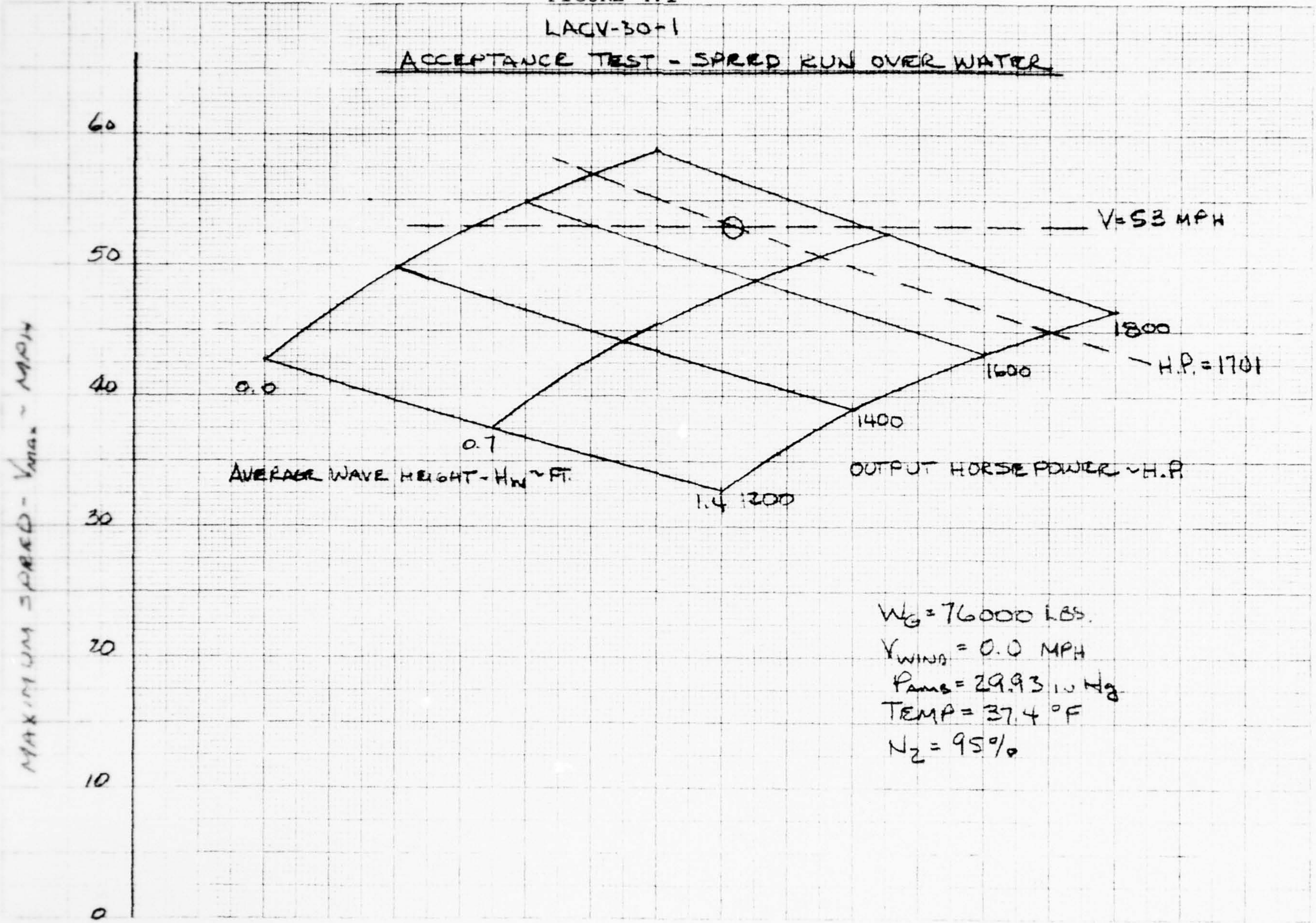
FIGURE 4.1



LACV-30-1
ACCEPTANCE TEST - SPEED RUN OVER WATER
MAXIMUM SPEED - Vmax. ~ MPH
60
50
40
30
20
10
0
V=53 MPH
1800
H.P.=1701
1600
1400
1200
0.0
0.7
1.4
AVERAGE WAVE HEIGHT - HW ~ FT.
OUTPUT HORSE POWER ~ H.P.
WG = 76000 LBS.
VWIND = 0.0 MPH
PAMB = 29.93 IN Hg
TEMP = 37.4 °F
N2 = 95%

FIGURE 4.2

LACV-30-2

ACCEPTANCE TEST - SPEED RUN OVER WATER

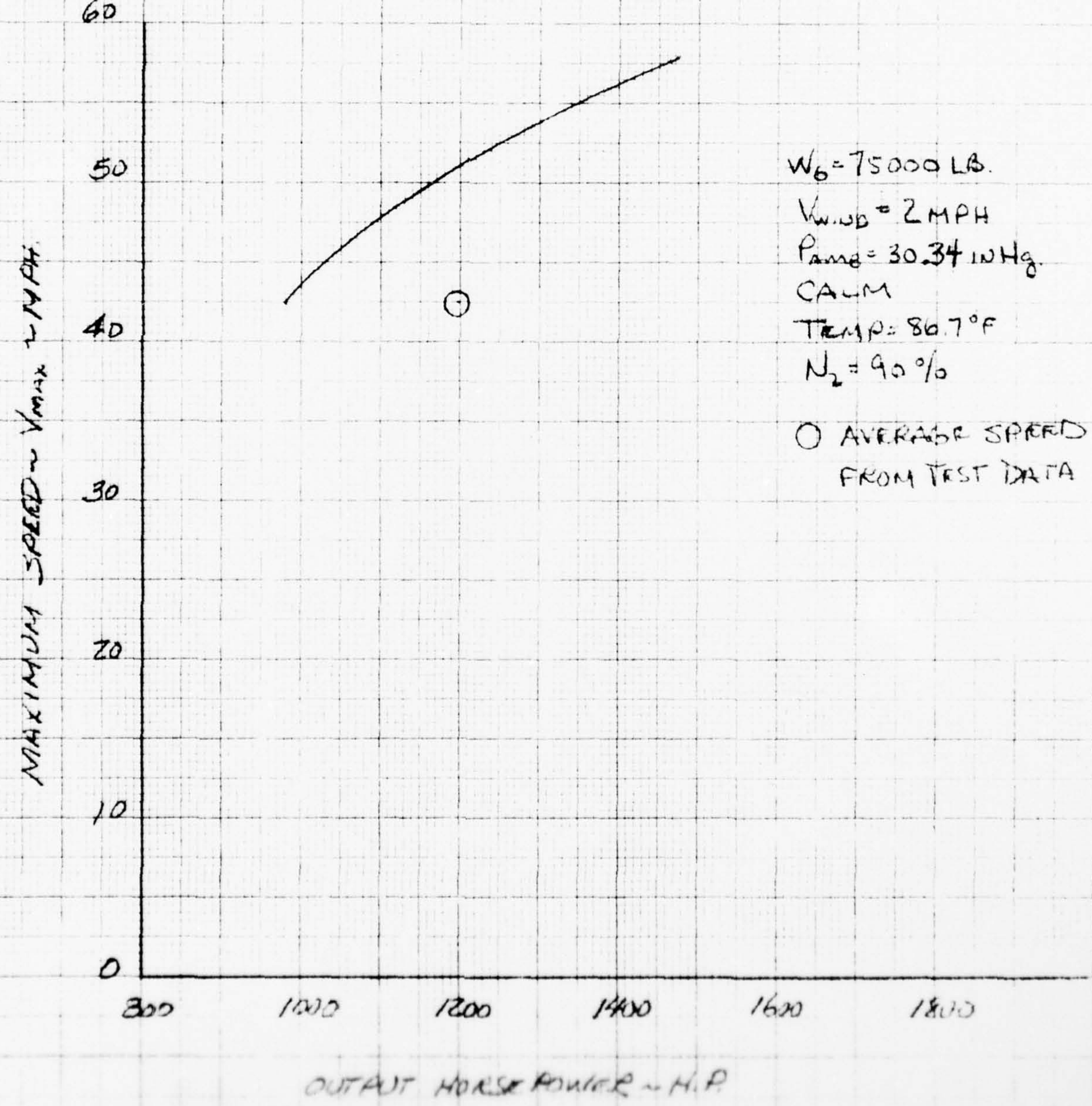


FIGURE 4.3
LACV-30-1

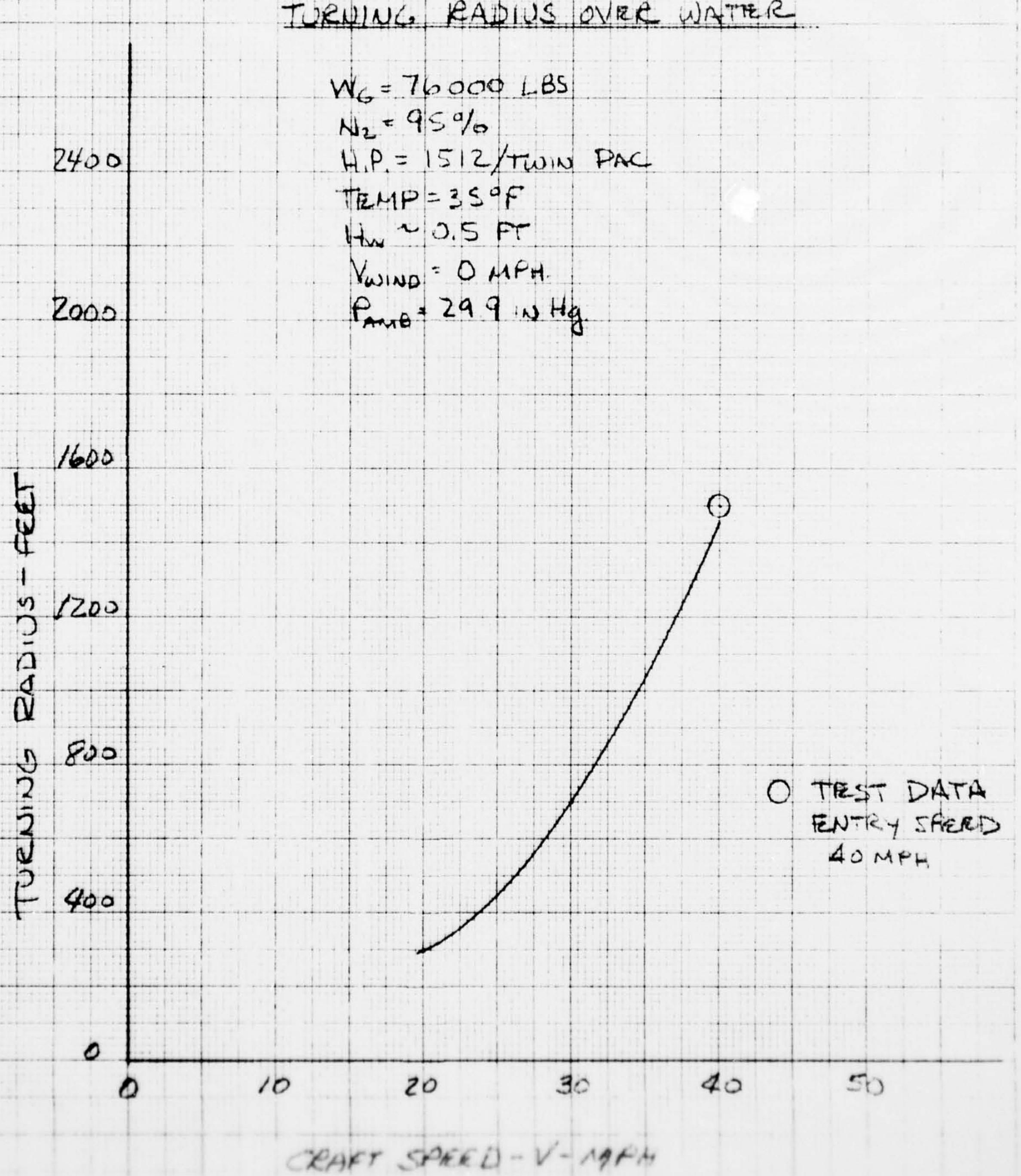
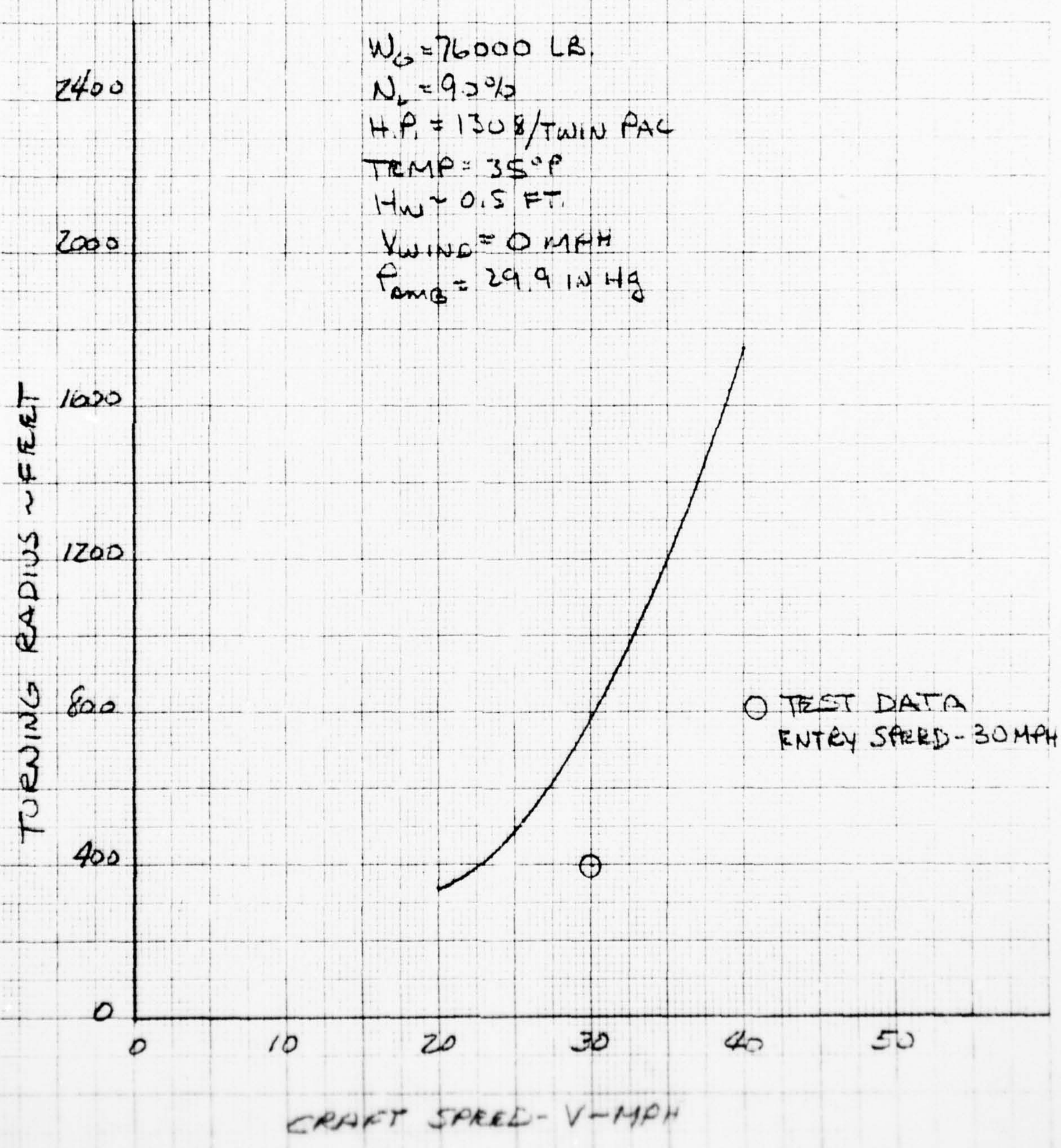


FIGURE 4.4

LACV-30-1

TURNING RADIUS OVER WATER



# APPENDIX A

# CONTRACTORS' ACCEPTANCE TESTS

# BELL AEROSPACE ACV TEST PLAN

| | | |
|---|---|---|
| BELL AEROSPACE ACV TEST PLAN | TYPE LACV-30-2 | OPER. NO. S2-0410 |

| ACV CREW | | NO CHASE AIRCRAFT | | 91,000 lb. TEST CONDITIONS | | |
|---|---|---|---|---|---|---|
| CREW POSITION | NAME | TYPE A/C | CREW | | TAKEOFF | LAND |
| Operator | G. Yeager | | | WEIGHT | 91,000 | 89,000 |
| Oper. NAV | R. Towers | | | FUEL | See Loading #2 | |
| Inst. | E. Schiffmacher | | | C.G. | 440 | |
| Engr. | R. Speth | INSTRUMENTATION PLAN | | BALLAST | | |
| | | SETUP NO. | AMEND NO. | ALT SETTING | 29.96 | |
| | | RADIO FREQ. | | PRESS ALT | 590' | |
| TEST ENGINEER | M. Laszewski | Not Required | | WIND | 020/20 | |
| TEST DIRECTOR | M. Laszewski | | | TEMP | +49° | +57° |
| FINAL GO-NO GO AUTHORITY | G. Yeager | | | | | |

**CRAFT CHANGES SINCE LAST OPERATION**

**TEST PURPOSE**

I. Skirt pressure survey at 91,000 lb. G.W.

II. Cabin contamination sampling.

| TEST ENGINEER | OPER. IN COMMAND | APPROVAL |
|---|---|---|
| Signed | Signed | |

**TEST PROCEDURE**

Position craft on selected concrete ramp. Perform standard checklists. Tether craft at stern.

I. Conduct skirt pressure survey in accordance with Attachment I (M. Laszewski's IOM).

II. During the above test, sample cabin atmosphere at breathing level for noxious and toxic fumes using sampling kit provided by Safety Engineering. Record data on Attachment II.

CABIN CONTAMINATION

(Tethered - Max. Power)

A. Craft Configuration:

| | | | | |
|---|---|---|---|---|
| T7 (°C) | 440 | 460 | 460 | 440 |
| $N_1$ (%) | 98.2 | 98.5 | 98.3 | 96.0 |
| $N_2$ (%) | 95 | 95 | 95 | 95 |
| TOP (psi) | 27 | 27 | 25 | 55 |

Air Conditioner OFF

Heater OFF

Cabin Vents CLOSED

B. Environment:

OAT (°C) +47°C

Baro. (in. Hg) 29.32

Wind Direction 050°

Craft Heading 230°

Wind Velocity 20 mph

C. Samples:

| Fumes | Measured (ppm) | Limit (ppm) |
|---|---|---|
| Carbon Monoxide | 20 | 50 |
| Carbon Dioxide | 3500 | 5000 |
| Nitrogen Dioxide | Unmeasurable | 5 |
| Sulfer Dioxide | Unmeasurable | 5 |
| Unburned Hydrocarbons | 50 | Various |
| | | |
| | | |
| | | |
| | | |
| | | |

OBSERVATIONS:

[illegible] [illegible] [illegible]
[illegible] [illegible] immediately [illegible] [illegible]
and hydrocarbons. [illegible] [illegible]
by [illegible] [illegible] [illegible]

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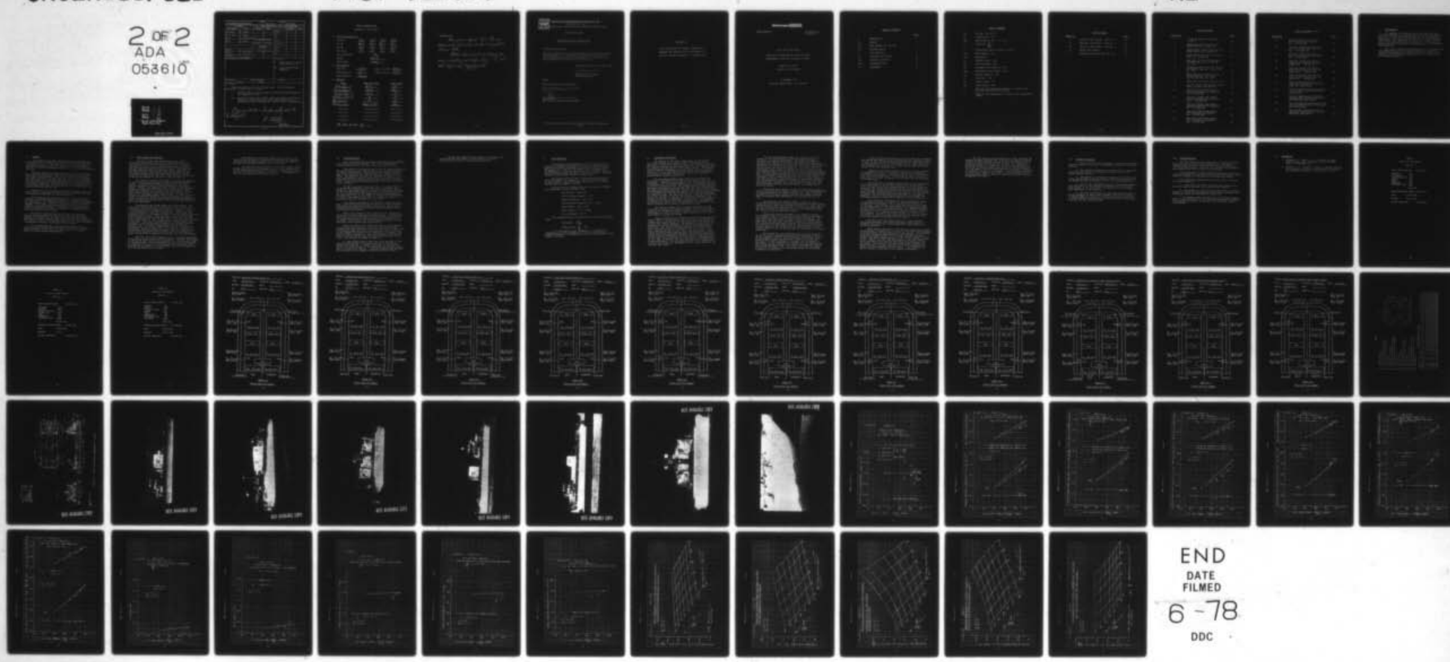
AD-A053 610 BELL AEROSPACE TEXTRON BUFFALO N Y F/G 1/3
LACV-30 TEST AND DEMONSTRATION REPORT.(U)
FEB 78 M M LASZEWSKI DAAK02-75-C-0149
UNCLASSIFIED 7467-928009 NL

2 OF 2
ADA
053610



END
DATE
FILMED
6-78
DDC

| BELL AEROSPACE ACV TEST PLAN | TYPE LACV-30-2 | OPER. NO. S2-0410 |
|---|---|---|

| ACV CREW | | NO CHASE AIRCRAFT | | 91,000 lb. TEST CONDITIONS | | |
|---|---|---|---|---|---|---|
| CREW POSITION | NAME | TYPE A/C | CREW | | TAKEOFF | LAND |
| Operator | G. Yeager | | | WEIGHT | | |
| Oper. NAV | R. Towers | | | FUEL | | |
| Inst. | E. Schiffmacher | | | C.G. | | |
| Engr. | R. Speth | INSTRUMENTATION PLAN | | BALLAST | | |
| | | SETUP NO. | AMEND NO. | ALT SETTING | | |
| | | RADIO FREQ. | | PRESS ALT | | |
| TEST ENGINEER | M. Laszewski | Not Required | | WIND | | |
| TEST DIRECTOR | M. Laszewski | | | TEMP | | |
| FINAL GO NO GO AUTHORITY | G. Yeager | | | | | |

CRAFT CHANGES SINCE LAST OPERATION

TEST PURPOSE

I. Skirt pressure survey at 91,000 lb. G.W.

II. Cabin contamination sampling.

| TEST ENGINEER | OPER. IN COMMAND | APPROVAL |
|---|---|---|
| Signed | Signed | |

TEST PROCEDURE

Position craft on selected concrete ramp. Perform standard checklists. Tether craft at stern.

I. Conduct skirt pressure survey in accordance with Attachment I (M. Laszewski's IOM).

II. During the above test, sample cabin atmosphere at breathing level for noxious and toxic fumes using sampling kit provided by Safety Engineering. Record data on Attachment II.

Copied DATA - Informally sent TO J. Sargent.

C. Stauffer
7/1/76

# CABIN CONTAMINATION

(Tethered - Max. Power)

A. Craft Configuration:

| | | | | |
|---|---|---|---|---|
| $T_5$ (°C) | 490 | 480 | 460 | 440 |
| $N_1$ (%) | 98.2 | 98.5 | 98.3 | 96.0 |
| $N_2$ (%) | 95 | 95 | 95 | 95.5 |
| TOP (psi) | 27 | 27 | 25 | 25 |

Air Conditioner: OFF

Heater: ON *

Cabin Vents: CLOSED

B. Environment:

| | | | |
|---|---|---|---|
| OAT (°C) | +9°C | Baro. (in. Hg) | 29.96 |
| Wind Direction | 195° | Craft Heading | 210° |
| Wind Velocity | 30 mph | | |

C. Samples:

| Fumes | Measured (ppm) | Limit (ppm) |
|---|---|---|
| Carbon Monoxide | 30-40 | 100 |
| Carbon Dioxide | 3500 | 5000 |
| Sulfer Dioxide | 2-3 | 5 |
| Nitrogen Dioxide | 0 | 5 |
| Benzene | 0 | 10 |
| Gasoline | Trace to 80 | 200 |
| | | |
| | | |
| | | |
| | | |

* One heater ho.

OBSERVATIONS:

This WAS A repeat Test. Previous measurements showed similar but incomplete Fume data.

Note that Tests for Aldehydes was reactive, not definitive; i.e., did not define the Types present.

WIRECO
WIRE ROPE

# WIRE ROPE CORPORATION OF AMERICA, INC.

*Fabricated Products Division*

609 North 2nd Street • P. O. Box 288 • Saint Joseph, Missouri 64502 • 816/233-0287 • Telex 42546

September 19, 1975

## CERTIFICATION OF PROOF TEST

To Whom It May Concern:

This is to certify that the 22 ton capacity adjust-a-leg wire rope assembly sold and shipped to The Caldwell Company Incorporated of Rockford, Illinois on their purchase order number 10353, file number 43753, have been proof tested to 84,000 pounds with legs vertical.

WIRE ROPE CORP. OF AMERICA, INC.

D. Giannattasio

D. Giannattasio, Manager
Fabricated Products

DG:sb

Subscribed And Sworn To Before Me

This 19th Day Of September, 1975

Notary Public
My Commission Expires March 7, 1979

MLS • STEEL GRIP • AL-GRIP • SUPER FLEX • SWAGED ASSEMBLIES • SUSPENDERS • SLING SPECIALTIES

APPENDIX B

1976 IR&D REPORT 7467-928002 "COMPARISON OF MEASURED AND PREDICTED HOVER PERFORMANCE OF LACV-30 VEHICLES AT BATNFO" 31 DECEMBER 1976

# Bell Aerospace TEXTRON

Division of Textron Inc.

Post Office Box One
Buffalo, New York 14240
716/297-1000

1976 IR&D FINAL REPORT

COMPARISON OF MEASURED AND PREDICTED HOVER
PERFORMANCE OF LACV-30 VEHICLES AT BATNFO

PROJECT NO. 21508

REPORT NO. 7467-928022

31 DECEMBER 1976

PRINCIPAL INVESTIGATOR: M. LASZEWSKI

# TABLE OF CONTENTS

## LIST OF SYMBOLS

| | |
|---|---|
| AG | Air Gap - in. or ft. |
| $B_C$ | Cushion beam - ft. |
| EAG | Equivalent Air Gap - in. or ft. |
| F | Froude No. $\frac{V}{\sqrt{gL_C}}$ |
| g | Acceleration due to gravity - ft/sec$^2$ |
| H.H. | Heave height - in. |
| H.P. | Horsepower |
| $L_C$ | Cushion length - ft. |
| $N_F$ | Lift Fan Speed - RPM |
| $P_B$ | Peripheral bag pressure - PSF |
| $P_{AB}$ | Anti-bounce bag pressure - PSF |
| $P_C$ | Cushion pressure - PSF |
| Q | Flow rate - CFS |
| $S_C$ | Cushion area - ft$^2$ |
| $W_G$ | Gross weight - lbs. |
| $\delta$ | Ratio of test barometric pressure to standard day sea level pressure (29.92 in.Hg) |
| $\theta$ | Ratio of test temperature to standard day temperature (59$^{\circ}$F) |

## LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES (Cont'd)

## I. INTRODUCTION

The purpose of the hover tests on the LACV-30-1 and LACV-30-2 vehicles was to obtain trunk and cushion characteristics for a number of gross weights and lift fan speeds for comparison to test data obtained from the Stretched Voyageur Model Tests. The comparison of full scale to model would be used to evaluate the accuracy of model data if necessary to obtain test scale factors for future model tests of comparable configurations.

This report includes a description of both vehicles, test instrumentation and data reduction techniques. Results are presented and compared to calculated values obtained from a computer program which uses model test data as the basis for lift system performance.

## II. SUMMARY

The purpose of the 1976 IR&D program was to perform full scale craft tests, evaluate the test results and correlate them with model test data. The initial task in the program was to perform hover tests of the full scale LACV-30-1 and LACV-30-2 vehicles at the Bell Aerospace Flight Test Facility in Wheatfield, New York.

The most extensive testing was performed on the LACV-30-1 where data was obtained for corrected gross weights of 83,678, 94,302 and 116,000 pounds. The lift fan speeds tested ranged from 930 to 980 RPM. All test data were corrected to standard day conditions for correlation and comparison. Instrumentation problems voided the test results obtained from the 83,678 pound gross weight condition. The LACV-30-2 test was performed for a corrected gross weight of 93,820 pounds and corrected lift fan speeds of 845, 907 and 955 RPM.

Analysis of the full scale test results indicate that the LACV-30 has a larger than predicted cushion footprint area with a corresponding reduction in cushion pressure.

The peripheral bag pressures measured in the tests were compared to predicted values obtained from a computer model of the lift system. The increased cushion area was used to calculate the predicted values. The use of immediate side deck pressure adjacent to the lift fan discharge area provided the best correlation to predicted values. A complete set of updated lift system performance predictions based upon the measured cushion area is included in this report.

The LACV-30 vehicle exhibited the same characteristic drop in bow bag pressure as seen on the Voyageur (002) craft; however, it appears that the addition of the stretch section resulted in a larger pressure drop from stern to bow bag pressure. The results of the 1/7.5 stretched Voyageur model tests indicated a negligible difference in peripheral bag pressure.

It is recommended that a continual monitoring of full scale data from the LACV-30 and Voyageur Vehicles be performed and the results incorporated into the computer lift system model for future design considerations.

## III. TEST PROGRAM AND VEHICLES

The hover flight test program performed at Bell Aerospace in Wheatfield, New York, involved the use of two test vehicles, the LACV-30-1 and the LACV-30-2. The two vehicles are similar to the configuration shown in Figure 1. The configurations tested included volutes in both lift fan plenums, modified stern seal and surf fence. The volutes and new stern seal installations were the outgrowth of the Stretched Voyageur Model test program performed in the ACV Laboratory at Wheatfield, New York. The LACV-30-1 vehicle had a swing crane mounted on the bow as shown in Figure 1.

The LACV-30-1 vehicle was tested in January and February of 1976 at three gross weights; 82,000, 92,000 and 116,000 pounds. Instrumentation problems, described in the next section, voided the results of the 82,000 pound test gross weight. However, the unusually large movement of ballast fuel required to keep the craft in level trim was noted at that weight and resulted in a change in the test program. In the light weight condition the vehicle was tested in only one position on the hangar apron; facing south. In order to investigate the ballast trim effect it was recommended in future tests to rotate the vehicle 180 degrees to establish whether the uneven ground plane or the vehicle itself necessitated ballast fuel trim adjustment.

The second gross weight tested was 92,000 pounds. The test weight was obtained by increasing the fuel on board and increasing the ballast weight in the MILVAN mounted on the deck. A weight breakdown is presented in Table I. Figures 2, 3 and 4 are photographs of the test configuration. Four tests were performed, two lift fan speeds at each of the two vehicle positions, facing south and north. After the test, a survey of the test site or cushion footprint area was made to determine the slope of the apron surface. The northern area of the test site was found to be level. This area is covered by the forward cushion compartments of the vehicle when the vehicle is pointed north and covered by the aft cushion compartments when the vehicle is pointed south. The slope at the southern end of the test site was higher, varying in angle from 1 to 3 degrees. Changes in ground slope will cause vehicle movement due to varying air gap, a shifting of ballast fuel to trim the craft in an attempt to keep it level would be required to minimize fore and aft movement.

The final test of the LACV-30-1 was to have been performed at the design gross weight of 115,000 pounds. However, 1000 pounds of additional fuel was put into the tanks for a final gross weight of 116,000 pounds. A weight breakdown for the test configuration is presented in Table II. The procedure was the same as in the previous test performed at 92,000 pounds, two lift fan speeds for each vehicle position on the apron.

The LACV-30-2 vehicle was tested in April 1976. The test site was changed to a concrete ramp between the Chemistry Building and the runway approach area. The concrete ramp was surveyed to determine the best area for the test.

The test program was limited to one gross weight, 92,000 pounds, and three lift fan speeds for one vehicle position, due to the limited availability of the vehicle. The weight breakdown for the test is presented in Table III. Photographs of the vehicle are presented in Figures 5, 6 and 7.

## IV. INSTRUMENTATION

All instrumentation was simple and direct visual readings were taken by the test engineer. The visual readings were recorded directly into data sheets for each specific run.

The intent of the program was to measure cushion pressures, bag and anti-bounce bag pressures and heave heights throughout the entire trunk system. The pressures were measured using an open ended tube which was inserted into the cushion and bag areas. The measuring stations are indicated in Table IV. The open ended probe was used in areas where low velocities were predicted and where dynamic pressures were expected to be negligible. These pressure readings represent both local total and static pressure.

In the first test of the LACV-30-1 at a gross weight of 82,000 pounds, Magnehelic gages were used to determine the pressures. Upon completion of the test the gages were returned to the Instrumentation Laboratory where it was discovered that the zero reading on all the gages had drifted significantly. The gages were reset to zero before a calibration could be made to correct the measured test data. No attempt was made to analyze the data for inclusion in this report.

The pressure readings in the remaining tests were read with a hand held pressure probe attached to a U-Tube marometer containing King indicating liquid. Corrections due to test temperature conditions were provided for data analysis by the instrumentation personnel.

Metal rods located at four corners of the vehicle were installed to provide deck heave height readings. Readings were taken with the craft resting on the landing pads in the power off condition and after trunk inflation at the specified lift fan speed. The intent of the heave height measurement was to determine cushion height and air gap height.

After two tests of the LACV-30-1 vehicle, gross weights of 82,000 and 92,000 pounds, it was felt that heave height measurements alone could not be used to determine air gap height. A calibrated wedge was used in the remaining tests to measure the gap between the bottom of the fingers and the ground. The wedge is shown in Figure 8. The gap measurements were read at stations 220 and 695 for both port and starboard sides of the craft. The stations are shown in Table IV.

It also became evident after the first two tests of the LACV-30-1 vehicle that the cushion area of the vehicle is larger than predicted. A cushion footprint of the LACV-30-1 vehicle at a gross weight of 116,000 pounds was obtained using chalk to outline the cushion. A cushion footprint was obtained for all three lift fan speeds during the LACV-30-2 tests.

Outside air temperature and barometric pressure were recorded on the data sheets. These data were used for normalizing test data to standard day conditions.

V. DATA REDUCTION

The bag and cushion pressure data were reduced by correcting the manometer readings for the test temperature and applying the proper conversion from inches of water to pounds per square foot. The two stern heave height readings were increased by 0.7 inches to account for the difference in deck height between the bow and stern measuring locations. The step decrease in deck height occurs at station 624.

The reduced data for each of the eleven tests are presented in Tables IVa through IVk. The data shown includes, $P_B$, bag pressure, $P_{AB}$, anti-bounce bag pressure, $P_C$, cushion pressure and AG, measured air gap.

For analysis the reduced data was corrected to standard day conditions, in the following form:

Bag Pressure $\sim P_B/\delta \sim$ PSF

Lift Fan Speed $\sim N_F/\sqrt{\theta} \sim$ RPM

Cushion Pressure $\sim P_C/\delta \sim$ RPM

Bag-to-Cushion pressure ratio $\sim P_B/P_C$

Gross Weight $\sim W_G/\delta \sim$ LBS.

Heave Height $\sim$ H.H. $\sim$ inches

Air Gap Height $\sim$ AG $\sim$ FT

The predicted hover characteristics include the following items:

Horsepower $\sim \dfrac{H.P.}{\delta \sqrt{\theta}}$

Cushion Flow $\sim \dfrac{Q}{\sqrt{\theta}} \sim$ CFS

$\theta$ is the ratio of test temperature to standard day temperature of 518.9$^{o}$ Rankine and $\delta$ is the ratio of test barometric pressure to standard day barometric pressure of 29.92 inches of mercury.

## VI. DISCUSSION OF RESULTS

The purpose of the hover flight tests on the LACV-30 full scale vehicle was to obtain trunk characteristics for comparison to predicted values obtained from a computer program. The computer program was developed using Stretched Voyageur model test data for determination of lift system losses. The program titled, VOYLSV3, calculates the total system air flow and distribution of flow, equivalent air gap (EAG), power requirements and pressures throughout the system. Details of the entire program can be found in reference 2.

The Stretched Voyageur model test data indicated the difference in peripheral bag pressure from stern to bow to be negligible. Therefore the average of all trunk pressure was used to determine the lift system losses from lift fan plenum to the side deck or peripheral bag. The computer program calculates one peripheral bag pressure and assumes that both lift fans provide the same bag pressure and flow. The air gap, which is the cushion flow discharge area between the bottom of the fingers and the ground is calculated using the sum of cushion flow from the peripheral and stability bags. The stern bag flow is a separate calculation and is not included in the air gap calculation because it is assumed to exhaust to atmosphere. The program has the capability to account for loss of flow due to leakage area. Because the leakage area was set to zero for this study, the calculated air gap is actually the so-called "equivalent air gap."

The cushion pressure ($P_C$) is calculated directly from input vehicle weight and cushion geometry. Since it is a major parameter in the program, cushion geometry must be correctly established in order to obtain a valid comparison of full scale test results to predicted values.

Figure 9 presents the variation of effective and measured cushion areas as a function of lift fan speed. The effective cushion area is defined as the test gross weight divided by the average test cushion pressure. The measured cushion areas were obtained from actual footprints of the vehicle at four test conditions. The initial design assumption of cushion area as shown in Figure 9 was for a cushion length ($L_C$) of 67.2 feet and a cushion beam ($B_C$) of 31.3 feet. As can be seen in the figure the test results indicate that the LACV-30 has a larger cushion area than previously assumed. The measured footprints varied in length from 69.8 to 70.5 feet and in width from 32.5 to 33.5 feet. For comparison to test results, a cushion length of 70.5 feet and beam of 33.5 feet were used to calculate predicted performance. The resultant cushion area is indicated by a solid line in Figure 9 and appears to be a good average of all the test data shown.

The stretched Voyageur model data indicated that the average of all peripheral bag pressures could be used to calculate lift system performance. An attempt was made to correlate the computed values with test data by averaging the peripheral bag pressures for each full scale test. The LACV-30-1 results for the 92,000 gross weight (or a corrected weight of 94,302 pounds) are shown in Figure 10. The solid line is the calculated values of bag and cushion pressures using the model test pressure loss of 0.5 to account for loss in pressure between the lift fan plenum and side bag. The average test bag pressures show a considerable disagreement with the predicted values. To determine if this discrepancy could be due to a small change in the loss coefficient, the coefficient was arbitrarily increased until agreement was reached. As shown in Figure 10, the test data shows good agreement with the calculated values only when the anticipated pressure loss coefficient is increased by a factor of three.

The flight test results for the corrected gross weight of 116,000 pounds shown in Figure 11 exhibit the same characteristics as those obtained in the lighter weight test. Again, average peripheral bag pressure aggrees with the calculated value only when the pressure loss coefficient is increased from 0.5 to 1.25.

The LACV-30-2 test results shown in Figure 12 for a corrected gross weight of 93,820 pounds exhibits the same characteristics as the test results shown in Figure 10. Based upon the results obtained from both vehicles it is quite apparent that the use of average bag pressure from the full scale craft does not correlate with the predicted values.

The pressure losses included in the computer program were obtained from 1/7.5 scale model tests where the peripheral bag pressure variation from stern to bow was negligible. The full scale test data shown in Table IV does not indicate the same trend. The test data indicates a decrease in bag pressure with increasing distance away from the lift fan discharge area. The pressure drop from stern to bow is approximately 15 percent. Of some concern is the stretched trunk system drop in bag-to-cushion pressure ratio at the bow and its relationship to plow-in tendencies.

The results of a trunk system pressure survey performed on the full scale Voyageur, craft 002, are presented in Table V. The data taken in June of 1972 indicates no significant change in bag pressure along the side deck. However, the bow bag pressure does drop an average of 7 percent for a majority of the tests. It can therefore be concluded that the addition of the stretch section resulted in a larger than expected pressure drop in the peripheral bag. This loss in pressure also makes it difficult to predict lift system performance using average peripheral bag pressures.

A more significant pressure that can be used for estimating lift system performance is the side bag pressure measured in the vicinity of the lift fan plenum discharge area. Here the pressure is only affected by the lift fan output and the obstructions in the discharge area and does not include losses which occur downstream of the fan discharge area.

Figures 13, 14 and 15 present flight test values obtained by averaging the most aft readings in the port and starboard peripheral bag sections. The center line of the 7 foot diameter lift fan is at station 740. The readings as shown in Table IV were taken at station 695 which is in the area of flow discharge to the side bag.

The predicted or computed values shown in the figures were calculated using the model test pressure loss coefficient of 0.5 to account for loss in pressure between lift fan plenum and side bag. The flight test results for the corrected weights of 94,302 pounds, 116,000 pounds and 93,820 pounds show good agreement with the calculated values of bag pressure. The correlation indicates that a modification should be made to the computer program to include a bow pressure calculation to account for downstream pressure losses and variation in total cushion flow.

The comparison of measured air gap and predicted values is presented in Figures 16 and 17 for corrected weights of 116,000 and 93,820 pounds. Only a limited amount of test data is available since air gap measurement using a calibrated wedge was introduced late in the test program. The computer program assumes level ground and uniform flow exiting from the bottom of the fingers with no leakage between fingers or corners of the trunk system. In reality the ground at the test site is uneven and efforts to keep the craft level resulted in variable exit flow areas around the periphery of the cushion.

The data shown in Figures 16 and 17 are the average of the gap measurements taken during the tests. Their general agreement with predicted values demonstrate satisfactory lift system performance.

Heave height measurements, the distance from ground to deck, are presented in Figures 18, 19 and 20 for corrected cross weights of 94,302 pounds, 116,000 pounds and 93,820 pounds. The predicted value was calculated using the sum of the predicted air gap, theoretical cushion height of 47.5 inches and deck height of 37.5 inches. The heave height reading for the no-gap condition should be 85.0 inches. All the test data shown in the three figures show a divergent trend with the predicted with decreasing lift fan speed. Factors which influence heave height readings are uneven ground at the test site and variation of peripheral bag shape with bag-to-cushion pressure ratio. The measured air gap is a better indication of lift system performance.

The test results can be considered to have validated the computer program, provided that the side bag pressure adjacent to the lift fan discharge area is used for bag pressure and an increased cushion area (2315 ft$^2$) is used. For future prediction purposes, the calculated lift system performance over the range of vehicle weights from 70,000 to 120,000 pounds and lift fan speeds from 695 to 1000 RPM are presented in Figures 21 through 25 as part of this report. The predicted performance includes total cushion flow ($Q/\sqrt{\theta}$), side bag pressure ($P_B/\delta$), bag-to-cushion pressure ratio, air gap (AG) and total required horsepower ($H.P./\delta\sqrt{\theta}$).

## VII. SUMMARY OF RESULTS

1. The full scale tests indicated a larger than predicted cushion footprint area with a corresponding reduction in cushion pressure.

2. The average peripheral bag pressure did not correlate with predicted values of bag pressure obtained from a lift system computer program.

3. Correlation of peripheral bag pressure with predicted values was obtained using the average of port and starboard side bag pressures measured adjacent to the lift fan discharge area.

4. The air gap measurement using the calibrated wedge was more indicative of lift system performances than the measured heave height at the deck level. The measured air gap heights were comparable to the predicted.

5. The LACV-30 exhibited the same characteristic drop in bow bag pressure as seen on the Voyageur (002) craft; however, it appears that the addition of the stretch section resulted in a larger decrease in bag pressure with increasing distance away from the lift fan discharge area.

## VIII. RECOMMENDATIONS

The full scale test data indicated a 15 percent pressure drop from stern to bow in the peripheral bag. Stretched Voyageur model test data, which is the basis for predicting lift system performance, indicated the difference in peripheral bag pressure from stern to bow to be negligible.

The discrepancy in trunk system characteristics must be resolved in order to establish prediction techniques where vehicle growth is obtained by stretching the existing seal system.

The following recommendations are being made to improve our design capability:

1. A continual monitoring of static bag pressure data from full scale craft such as the LACV-30 and Voyageur.

2. Incorporation of the full scale data into the computer program to include bow bag pressure calculations accounting for downstream losses and variations in total flow.

3. An attempt should be made using the stretch Voyageur model to determine model to full scale relationship with regards to bag shape and pressure distribution and establish areas of discrepancies.

## IX. REFERENCES


1. Laszewski, M. & Watt, C. S., "Stretched Voyageur Model Testing," Bell Aerospace, Report No. 7467-927001, 31 December 1974.

2. Bissell, J. R., "VOYLSV3 - A Digital Computer Program for Evaluating ACV Type Lift/Seal System Performance," Bell Aerospace, Report No. 7467-927013, May 1976.

TABLE I

LACV-30-1 TEST WEIGHT

TEST NO. 2

| | | |
|---|---|---|
| BASIC CONFIGURATION | | 58,072 LBS. |
| LASHINGS | 475 | |
| AFT PALLET | 945 | |
| PALLET TIE BAR | 85 | |
| MILVAN | 4745 | |
| CREW | 360 | |
| PASSENGER | 360 | |
| UNUSEABLE FUEL | 650 | |
| | 7620 LBS. | |
| OPERATING WEIGHT EMPTY | | 65,692 LBS |
| FUEL | 12,583 LBS. | |
| BALLAST | 13,725 LBS. | |
| FLIGHT CONDITION | | 92,000 LBS. |

TABLE II

LACV-30-1 TEST WEIGHT

TEST NO. 3

| | | |
|---|---|---|
| BASIC CONFIGURATION | | 58,240 LBS. |
| LASHINGS | 950 | |
| PALLETS | 2008 | |
| PALLET TIE BARS | 170 | |
| MILVANS (2) | 9345 | |
| CREW | 360 | |
| PASSENGERS | 360 | |
| UNUSEABLE FUEL | 650 | |
| | 13,843 LBS. | |
| OPERATING WEIGHT EMPTY | | 72,083 LBS. |
| FUEL | 18,546 LBS. | |
| BALLAST | 25,371 | |
| FLIGHT CONDITION | | 116,000 LBS. |

TABLE III

LACV-30-2 TEST WEIGHT

TEST NO. 1

| | | |
|---|---|---|
| BASIC CONFIGURATION | | 51,859 LBS. |
| LASHING | 428 | |
| PALLET | 2064 | |
| PALLET TIE BAR | 170 | |
| MILVAN | 4745 | |
| CREW | 360 | |
| PASSENGERS | 360 | |
| UNUSEABLE FUEL | 650 | |
| TEE HOOKS | 152 | |
| | 8929 LBS. | |
| OPERATING WEIGHT EMPTY | | 60,788 LBS. |
| FUEL | 16,881 LBS. | |
| BALLAST | 14,331 LBS. | |
| FLIGHT CONDITION | | 92,000 LBS. |

VEHICLE LACV-30-1 Facing North (1)

TIME 10:00 a.m. OAT/BARO 21°F/29.17 DATE: 1/30/76

WEIGHT 92,000 lbs. WIND

$N_2$ 91% FAN RPM 905

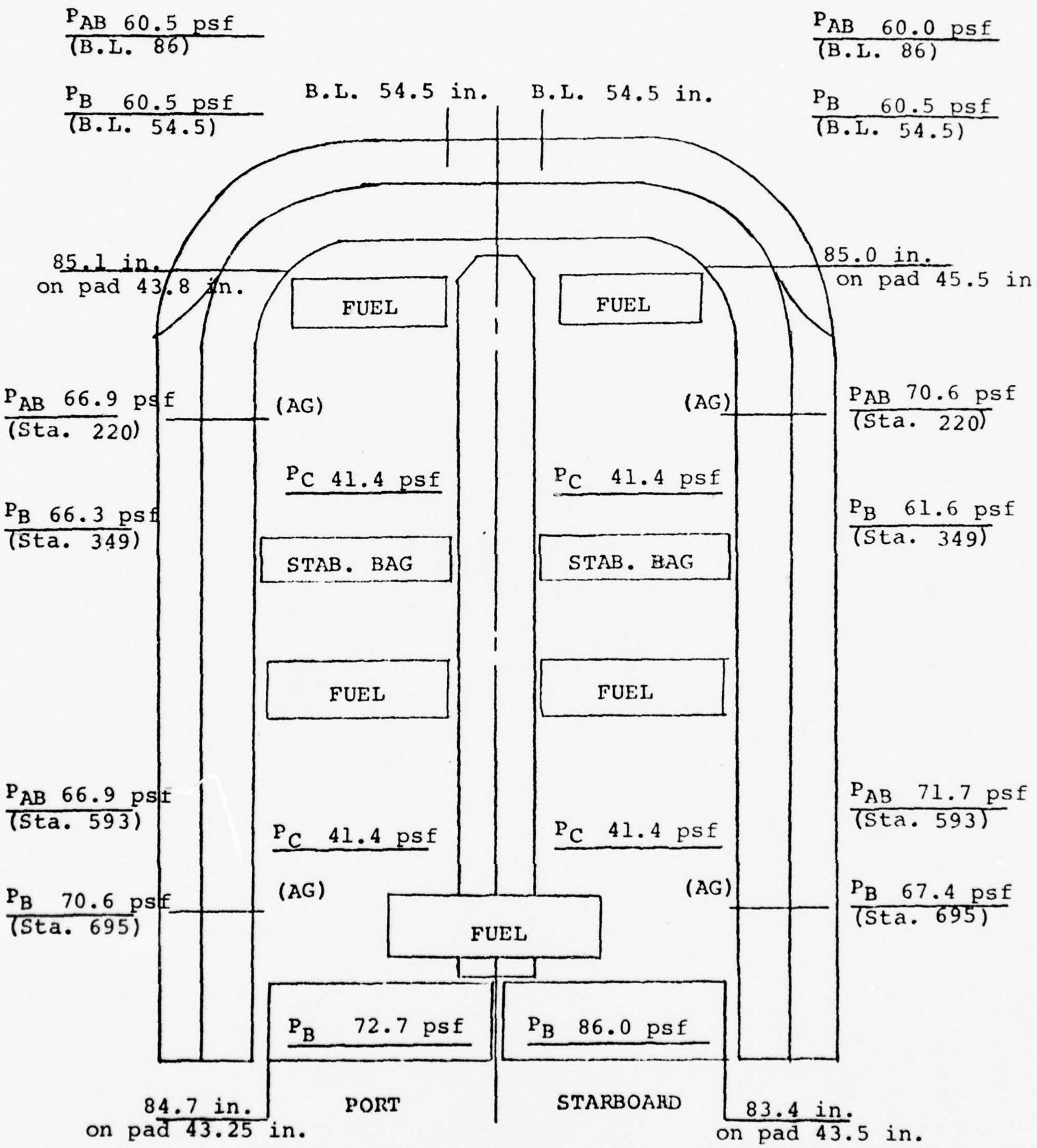



TABLE $IV_a$

STATIC TEST RUN SUMMARY

VEHICLE LACV-30-1 Facing North (2)

TIME 11:00 a.m. OAT/BARO $21^{o}F/29.17$ DATE: 1/30/76

WEIGHT 92,000 lbs. WIND

$N_2$ 93.5% FAN RPM 930

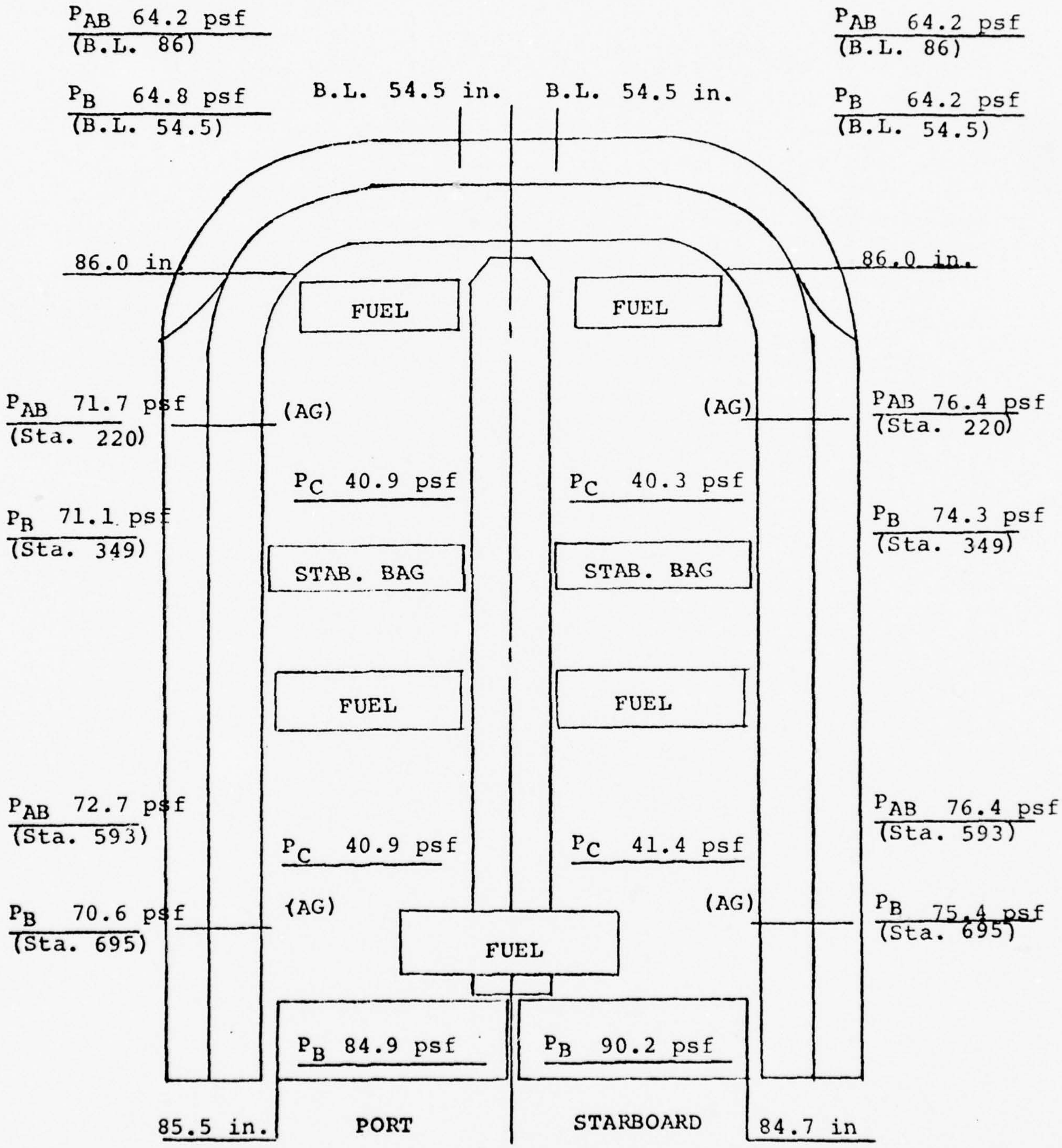



TABLE IV b

STATIC TEST RUN SUMMARY

VEHICLE LACV-30-1 Facing South (3)

TIME 2:30 p.m. OAT/BARO $23^{\circ}F/29.17$ DATE: 1/30/76

WEIGHT 92,000 lbs. WIND

$N_2$ 91% FAN RPM 905

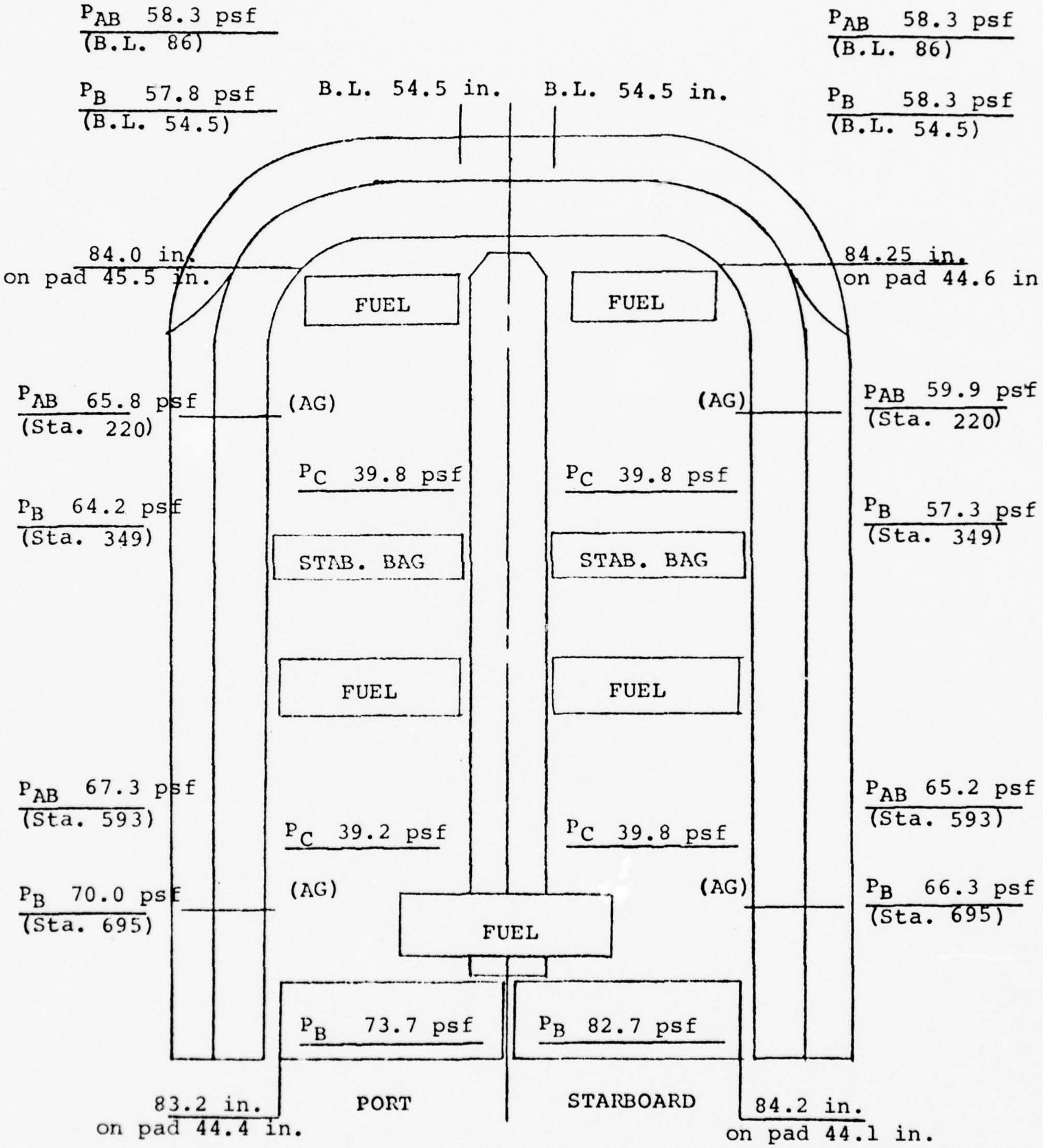



TABLE IVc

STATIC TEST RUN SUMMARY

VEHICLE LACV-30-1 Facing South (4)

TIME 3:30 p.m. OAT/BARO 23°F/29.17 DATE: 1/30/76

WEIGHT 92,000 lbs. WIND

$N_2$ 95.8% FAN RPM 953

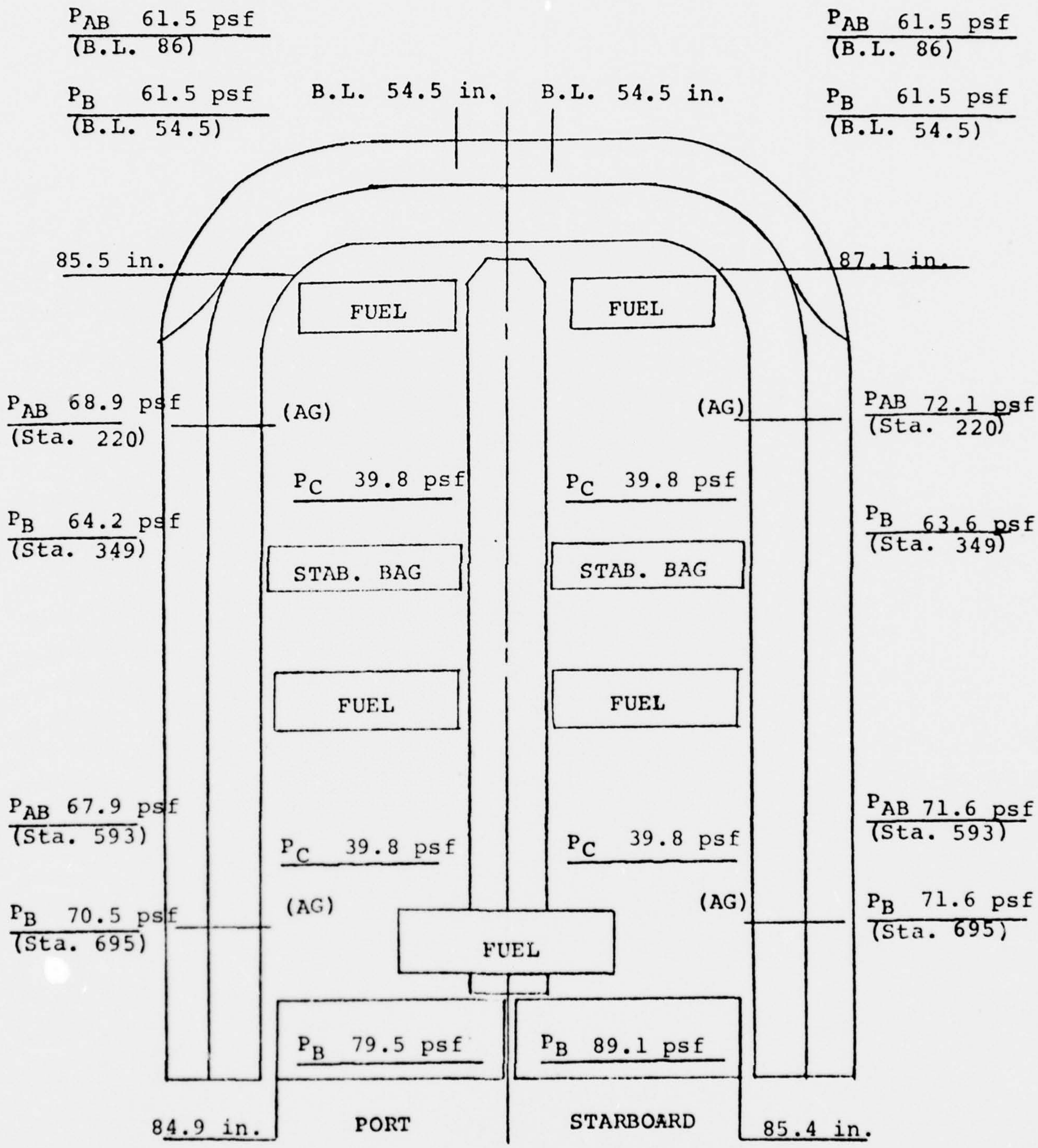



TABLE IV d

STATIC TEST RUN SUMMARY

VEHICLE LACV-30-1 Facing South (1)

TIME 11:00 a.m. OAT/BARO $32^{o}F/29.93$ DATE: 2/14/76

WEIGHT 116,000 lbs WIND

$N_2$ 91% FAN RPM 905

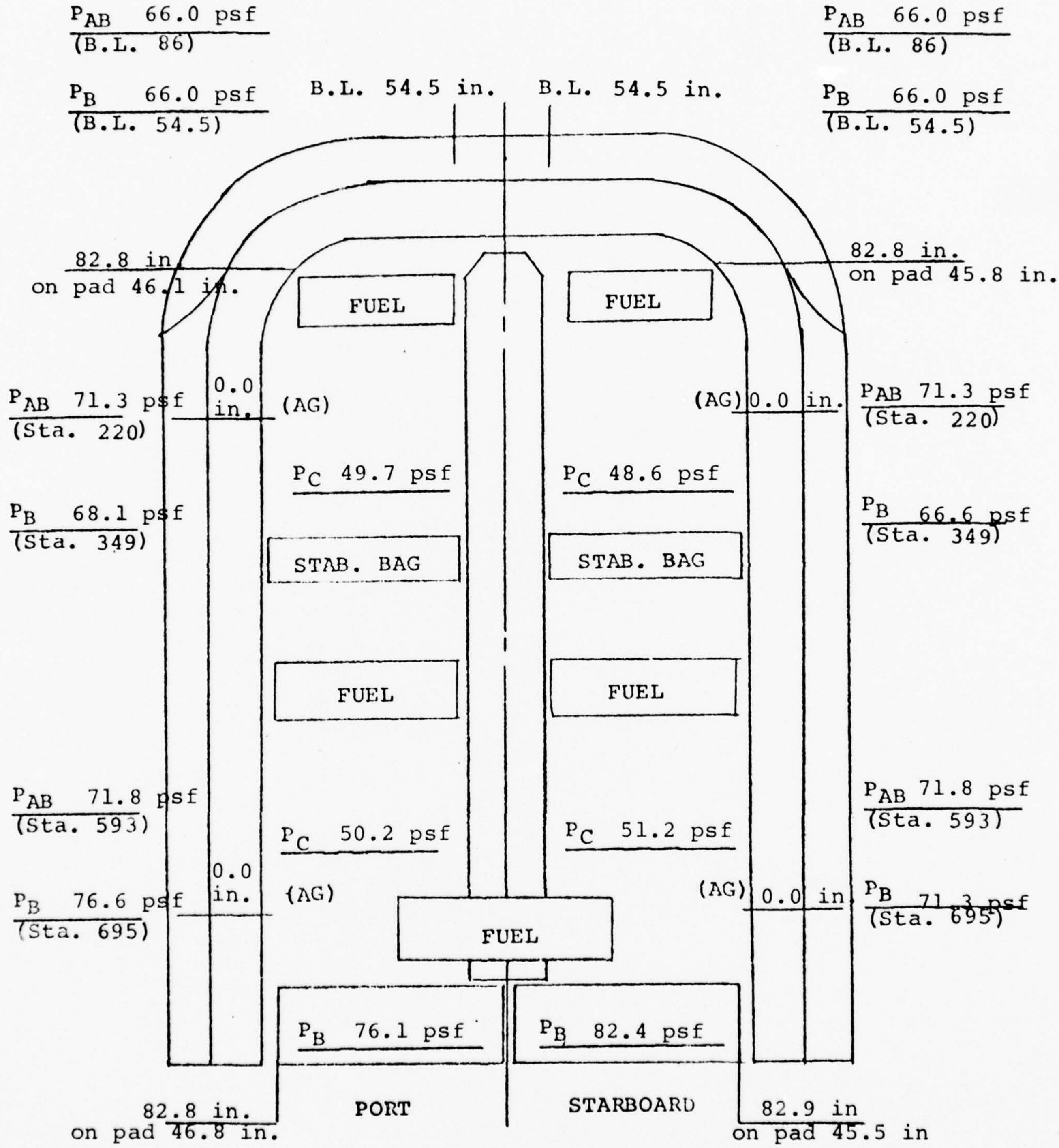



TABLE IV e

STATIC TEST RUN SUMMARY

VEHICLE LACV-30-1 Facing South (2)

TIME 11:20 a.m. OAT/BARO $32^{\circ}F/29.93$ DATE: 2/14/76

WEIGHT 116,000 lbs. WIND 8 mph 320 deg.

$N_2$ 95% FAN RPM 945

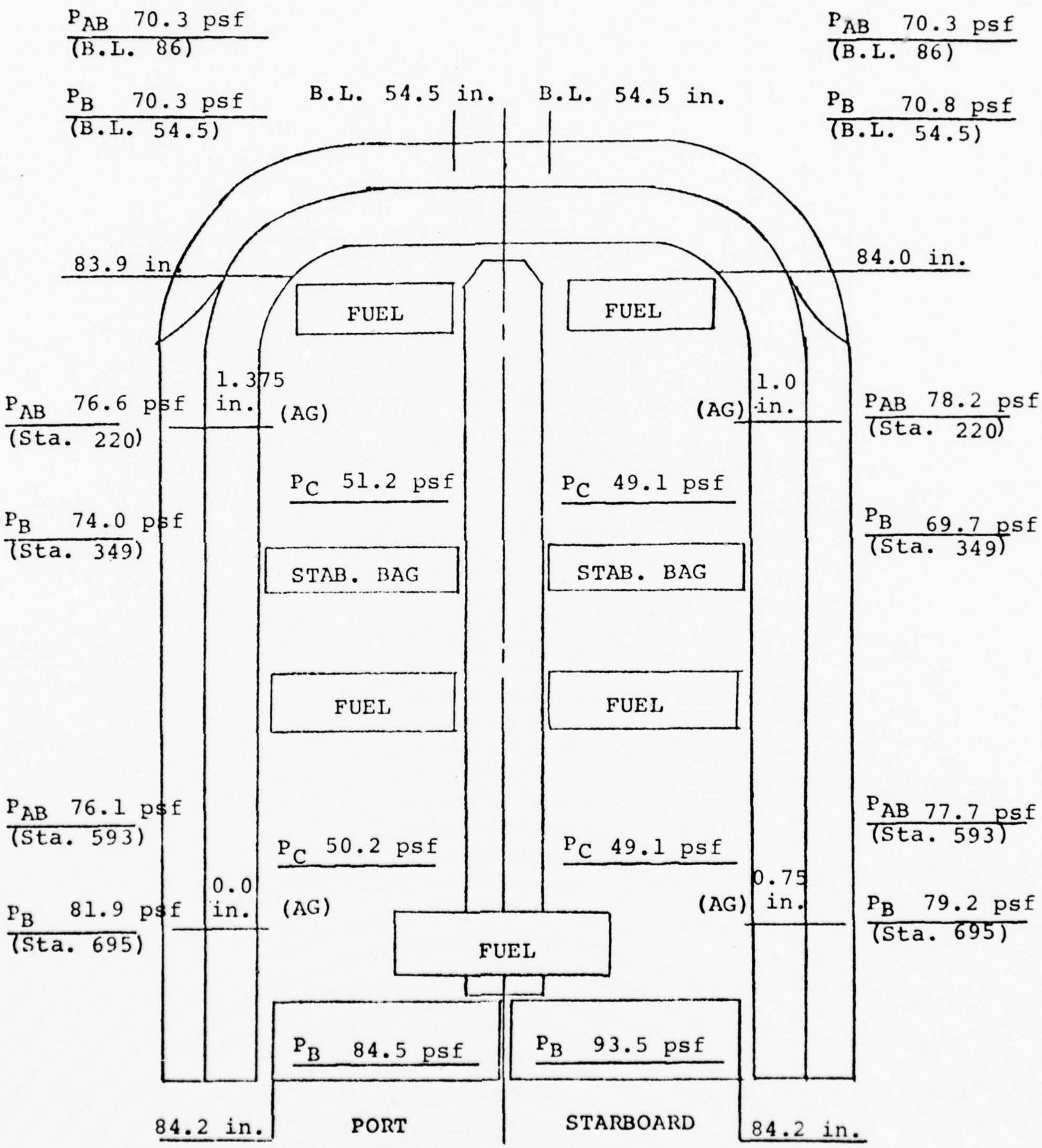



TABLE IVf

STATIC TEST RUN SUMMARY

VEHICLE LACV-30-1 Facing North (3)

TIME 1:34 p.m. OAT/BARO $32^{o}F/29.93$ DATE: 2/14/76

WEIGHT 116,000 lbs WIND

$N_2$ 91% FAN RPM 905

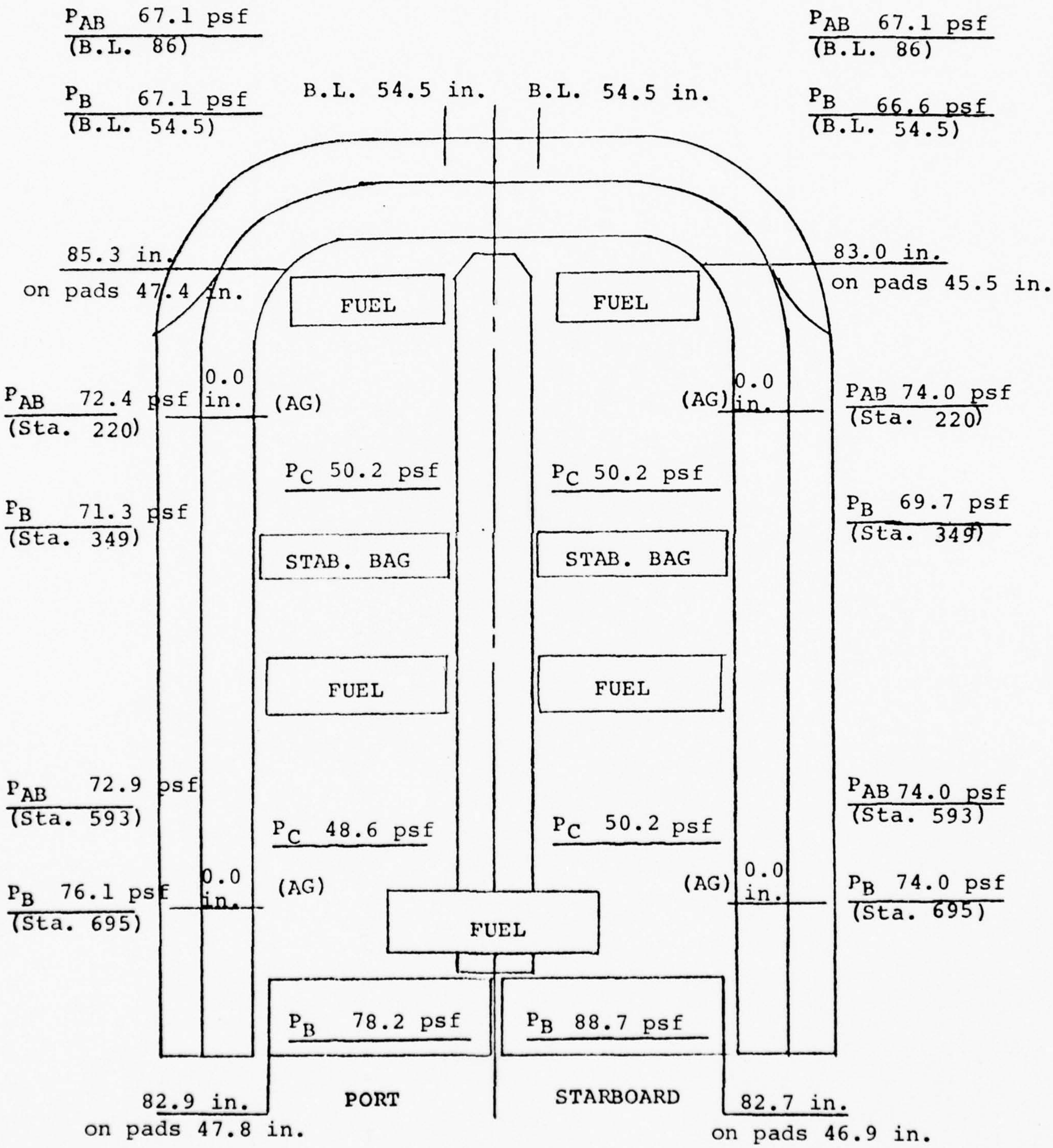



TABLE IVg

STATIC TEST RUN SUMMARY

VEHICLE LACV-30-1 Facing North (4)

TIME 2:00 p.m. OAT/BARO $32^{o}F/29.93$ DATE: 2/14/76

WEIGHT 116,000 lbs. WIND

$N_2$ 96.25% FAN RPM 957

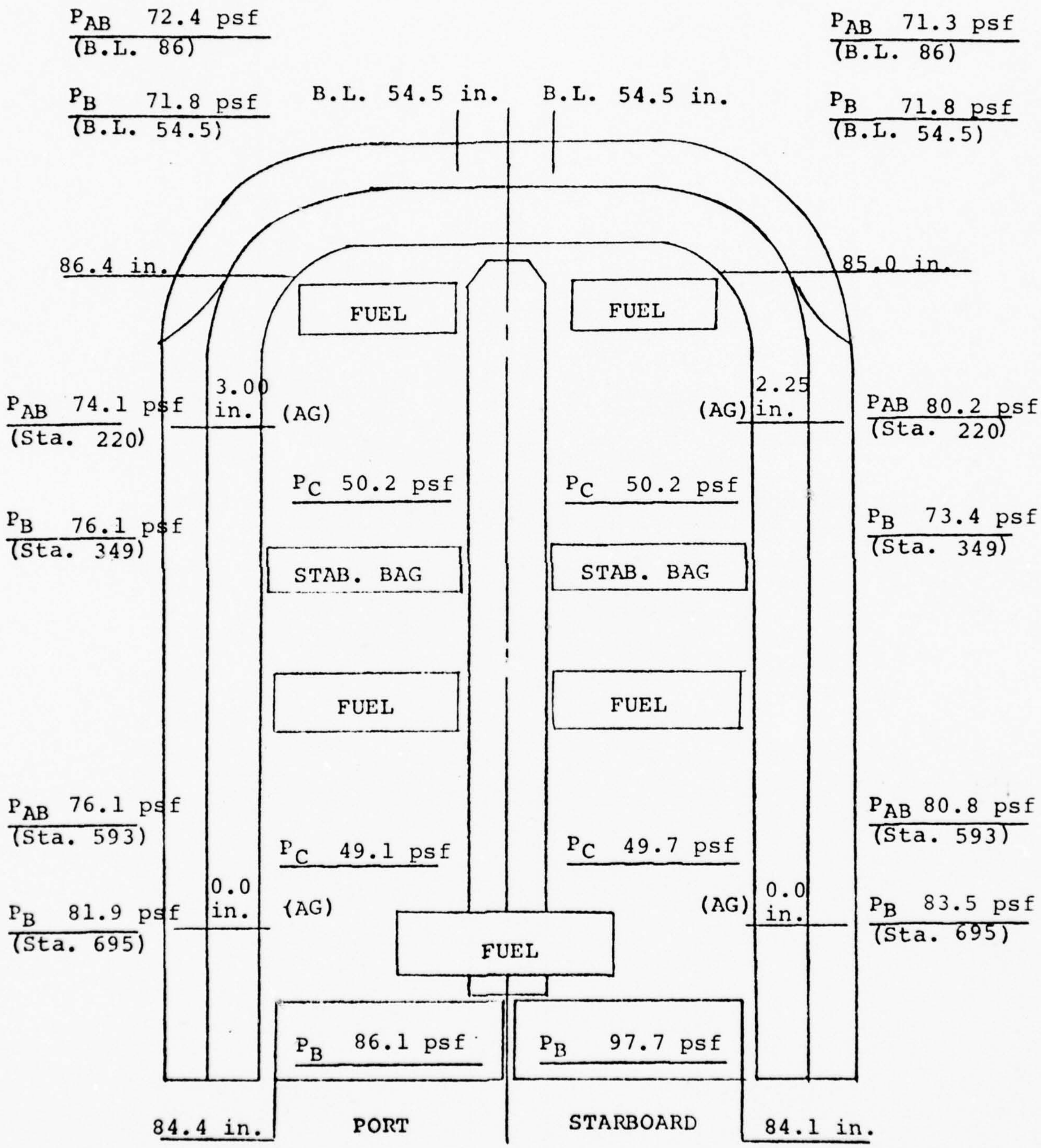



TABLE IV h

STATIC TEST RUN SUMMARY

VEHICLE LACV-30-2 on concrete ramp towards airport

TIME 1:00 p.m. OAT/BARO $49^{\circ}F/29.32$ DATE: 4/10/76

WEIGHT 92,000 lb. WIND

$N_2$ 95% FAN RPM 945

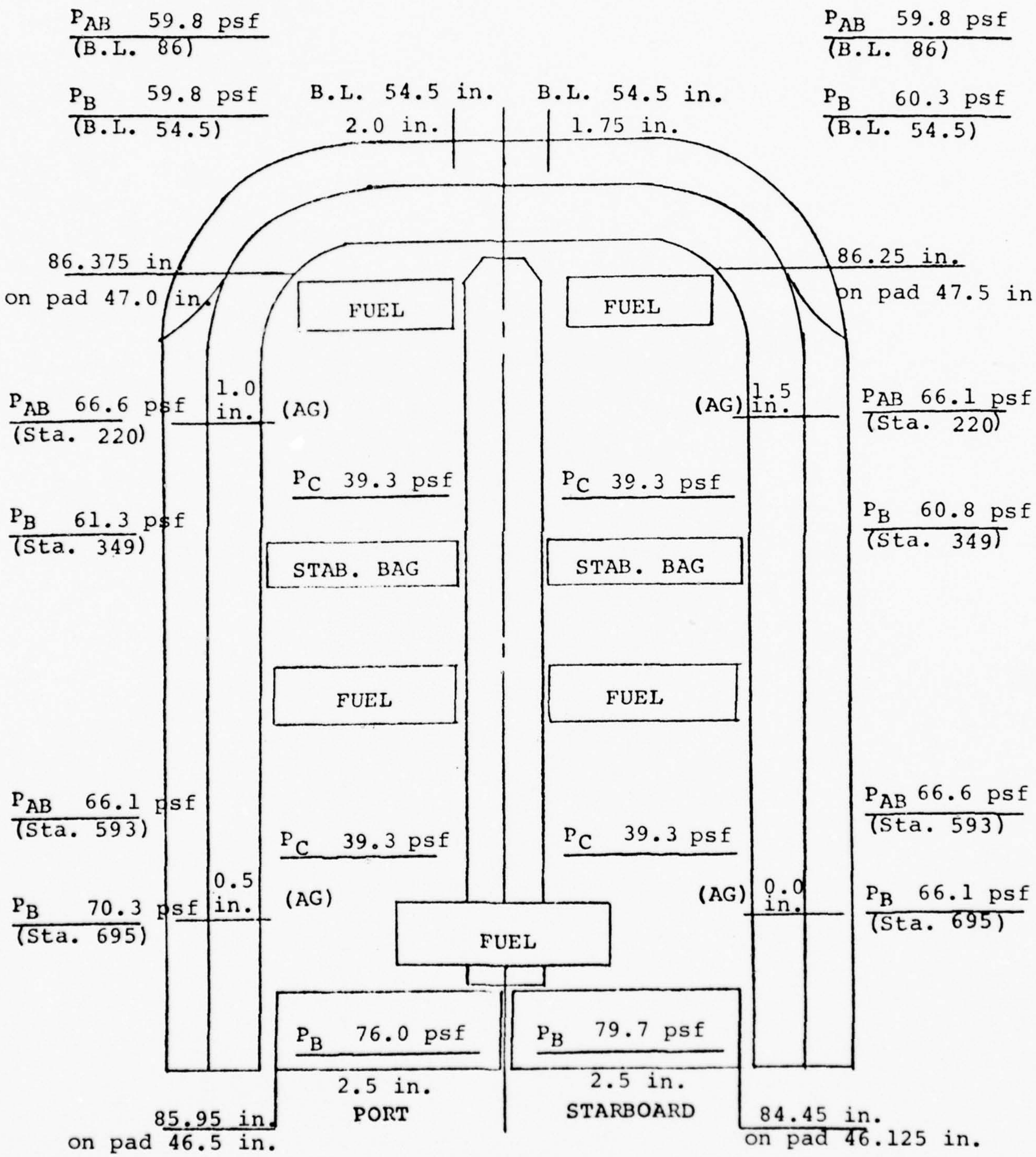



TABLE IV i

STATIC TEST RUN SUMMARY

VEHICLE LACV-30-2 on concrete ramp towards airport

TIME 1:55 p.m. OAT/BARO 57°F/29.32 DATE: 4/10/76

WEIGHT 92,000 lbs. WIND

$N_2$ 90% FAN RPM 905

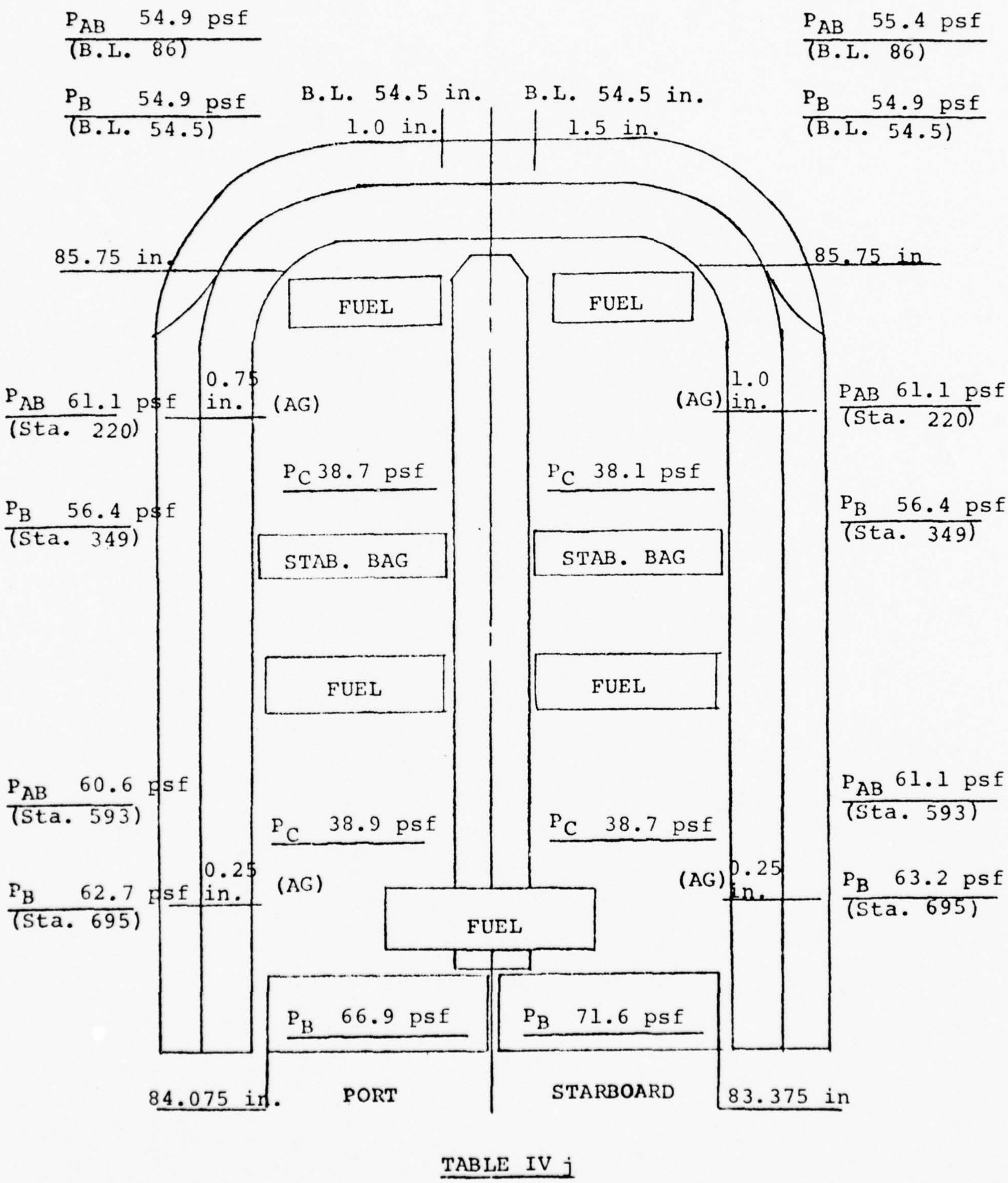



TABLE IV j

STATIC TEST RUN SUMMARY

VEHICLE LACV-30-2 on concrete ramp towards airport

TIME ~~2:30 p.m.~~ OAT/BARO $57^{O}F/29.32$ DATE: 4/10/76

WEIGHT 92,000 lbs. WIND

$N_2$ 85% FAN RPM

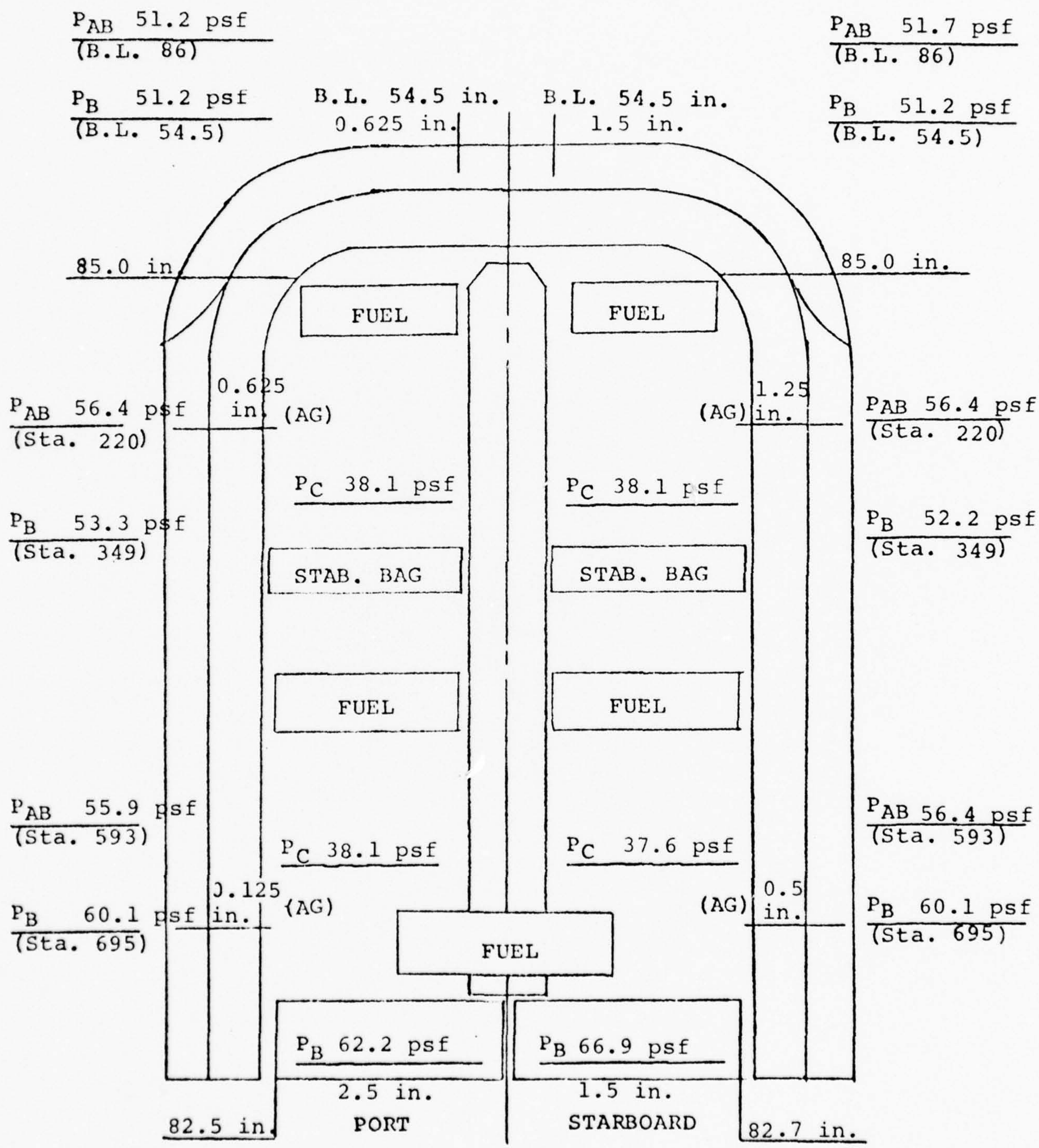
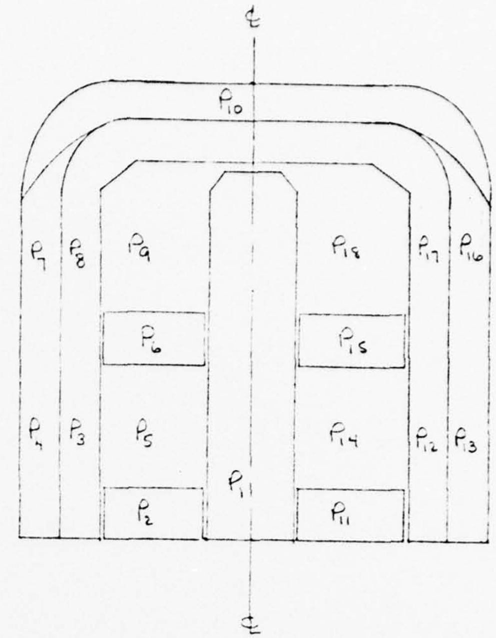



TABLE IV k

STATIC TEST RUN SUMMARY

## TABLE V

| | |
|---|---|
| $P_1$ | Center Keel Pressure |
| $P_2$ | Port Pear Trunk Pressure |
| $P_3$ | Port Aft Inner Peripheral Trunk Pressure |
| $P_4$ | Port Aft Outer Peripheral Trunk Pressure |
| $P_5$ | Cushion Pressure |
| $P_6$ | Port Stability Trunk Pressure |
| $P_7$ | Port Forward Outer Peripheral Trunk Pressure |
| $P_8$ | Port Forward Inner Peripheral Trunk Pressure |
| $P_9$ | Cushion Pressure |
| $P_{10}$ | Bow Trunk Pressure |
| $P_{11}$ | Stbd. Rear Trunk Pressure |
| $P_{12}$ | Stbd. Aft Inner Peripheral Trunk Pressure |
| $P_{13}$ | Stbd. Aft Outer Peripheral Trunk Pressure |
| $P_{14}$ | Cushion Pressure |
| $P_{15}$ | Stbd. Stability Trunk Pressure |
| $P_{16}$ | Stbd. Forward Outer Peripheral Trunk Pressure |
| $P_{17}$ | Stbd. Forward Inner Peripheral Trunk Pressure |
| $P_{18}$ | Cushion Pressure |




VOYAGEUR 002 STATIC TEST JUNE 1972

| CRAFT WEIGHT (LB) | $N_2$ (%) | $T_{AMB}$ (°F) | $P_1$ | $P_2$ | $P_3$ | $P_4$ | $P_5$ | $P_6$ | $P_7$ | $P_8$ | $P_9$ | $P_{10}$ | $P_{11}$ | $P_{12}$ | $P_{13}$ | $P_{14}$ | $P_{15}$ | $P_{16}$ | $P_{17}$ | $P_{18}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 45,000 | 90 | 65 | 60.3 | 62.9 | 54.6 | 58.7 | 24.0 | 53.1 | 59.3 | 55.1 | 26.6 | 51.5 | 68.1 | 56.7 | 59.8 | 26.5 | 53.1 | 59.8 | 56.7 | 38.1 |
| 49,600 | 90 | 49 | 61.1 | 63.7 | 55.9 | 61.1 | 31.2 | 54.1 | 59.8 | 57.2 | 31.2 | 53.3 | 67.6 | 54.6 | 62.4 | 31.2 | 54.1 | 64.4 | 57.2 | 31.2 |
| 64,000 | 90 | 55 | 65.0 | 70.2 | 59.8 | 65.0 | 34.8 | 59.8 | 65.0 | 62.4 | 39.0 | 62.4 | 72.8 | 62.0 | 65.0 | 33.0 | 59.8 | 66.0 | 60.0 | 39.0 |
| 78,000 | 90 | 65 | 66.6 | 70.2 | 65.0 | 66.6 | 42.0 | 62.4 | 66.3 | 64.4 | 45.5 | 60.9 | 71.5 | 61.1 | 67.6 | 42.6 | 62.4 | 65.0 | 65.0 | 45.5 |
| 78,000 | 90 | 80 | 65.0 | 65.0 | 59.8 | 62.4 | 41.6 | 65.0 | 62.4 | 61.1 | 46.8 | 57.2 | 70.2 | 61.1 | 63.7 | 44.2 | 65.0 | 63.7 | 62.4 | 46.8 |
| 88,000 | 90 | 80 | 67.6 | 64.0 | 65.5 | 65.5 | 46.8 | 64.0 | 67.6 | 65.5 | 51.0 | 62.9 | 74.9 | 64.5 | 68.6 | 49.4 | 65.0 | 69.7 | 60.0 | 52.0 |

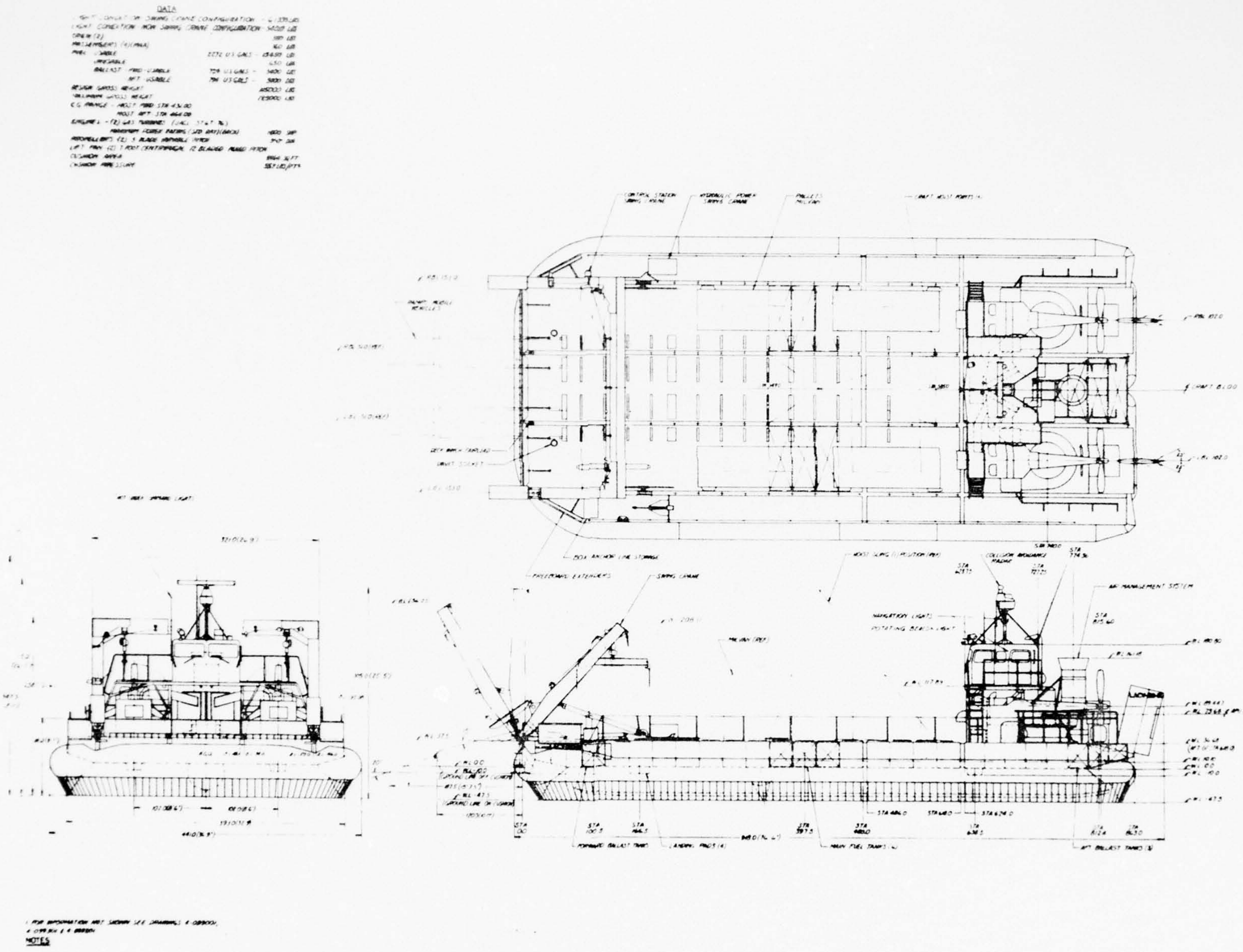



FIGURE 1. 3 VIEW AND GENERAL ARRANGEMENT - LACV-30

FIGURE 2. STARBOARD VIEW OF LACV-30-1 ON HANGAR RAMP, $W_G$ = 92,000 LBS.

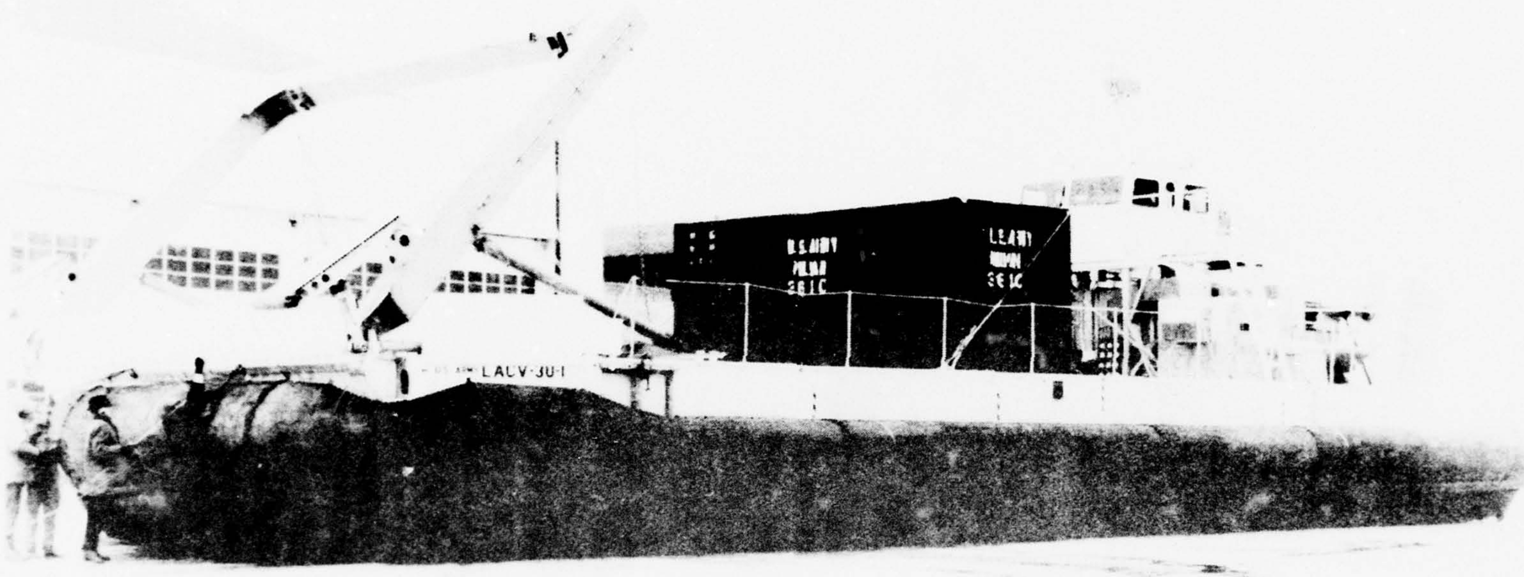



FIGURE 8. THREE QUARTER VIEW OF LACV-30-1 ON HANGAR RAMP, $W_G$ = 92,000 LBS.

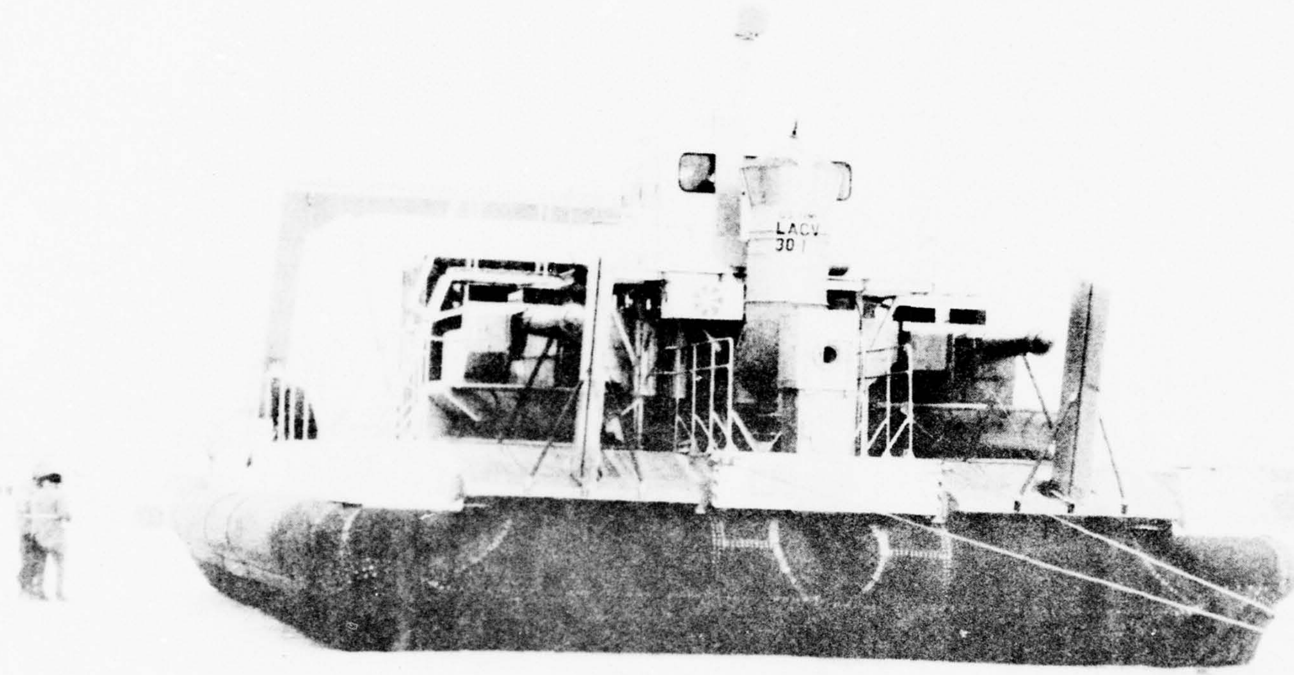



FIGURE 4. STERN VIEW OF LACV-30-1 ON HANGAR RAMP, $W_G$ = 92,000 LBS.

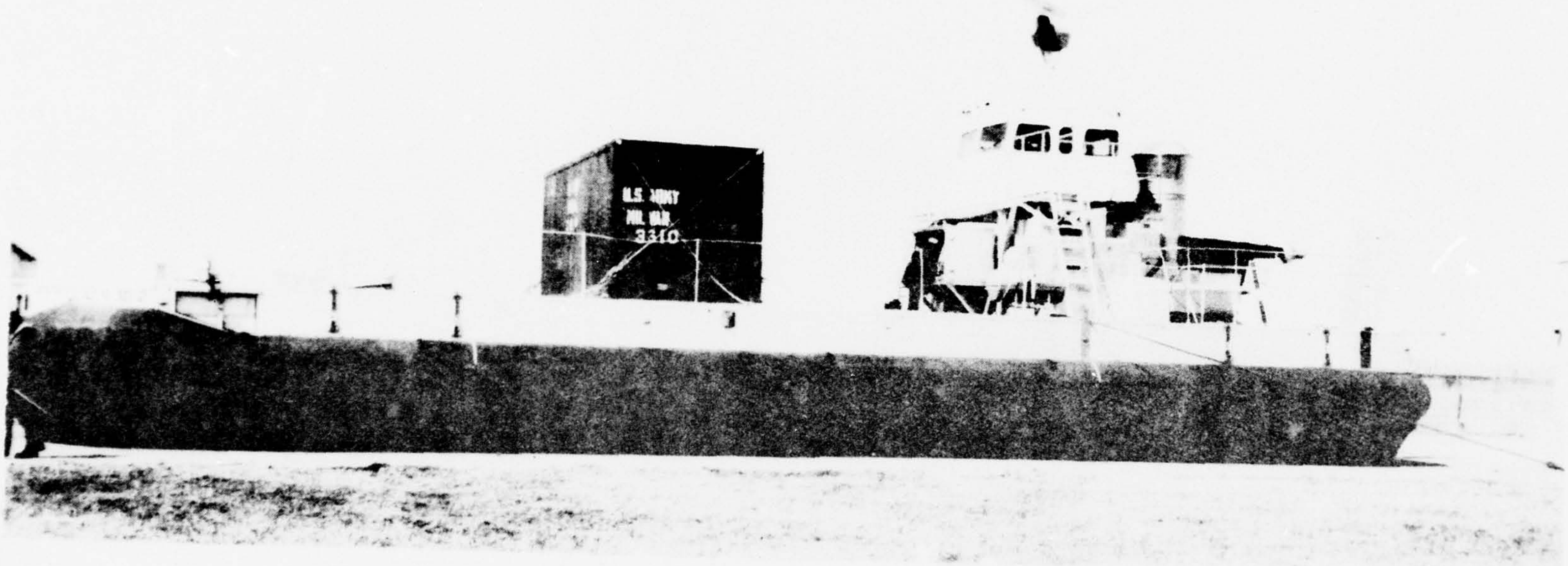



FIGURE 5. PORT VIEW OF LACV-30-2 VEHICLE ON CONCRETE RAMP, $W$ = [illegible] LBS., $N$ = [illegible]%

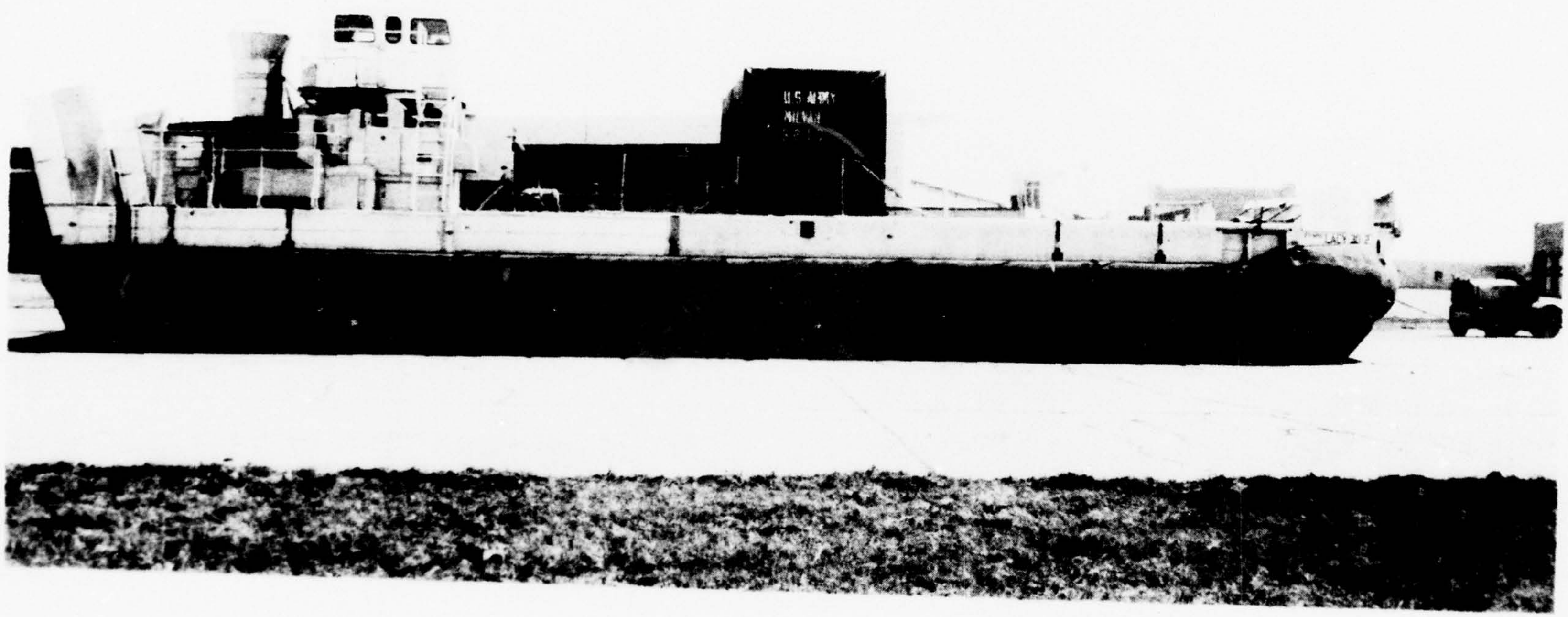


FIGURE 6. STARBOARD VIEW OF LACV-30-2 VEHICLE ON CONCRETE RAMP, $W_G$ = 92,000 LBS., $N_2$ = 90%

BEST AVAILABLE COPY

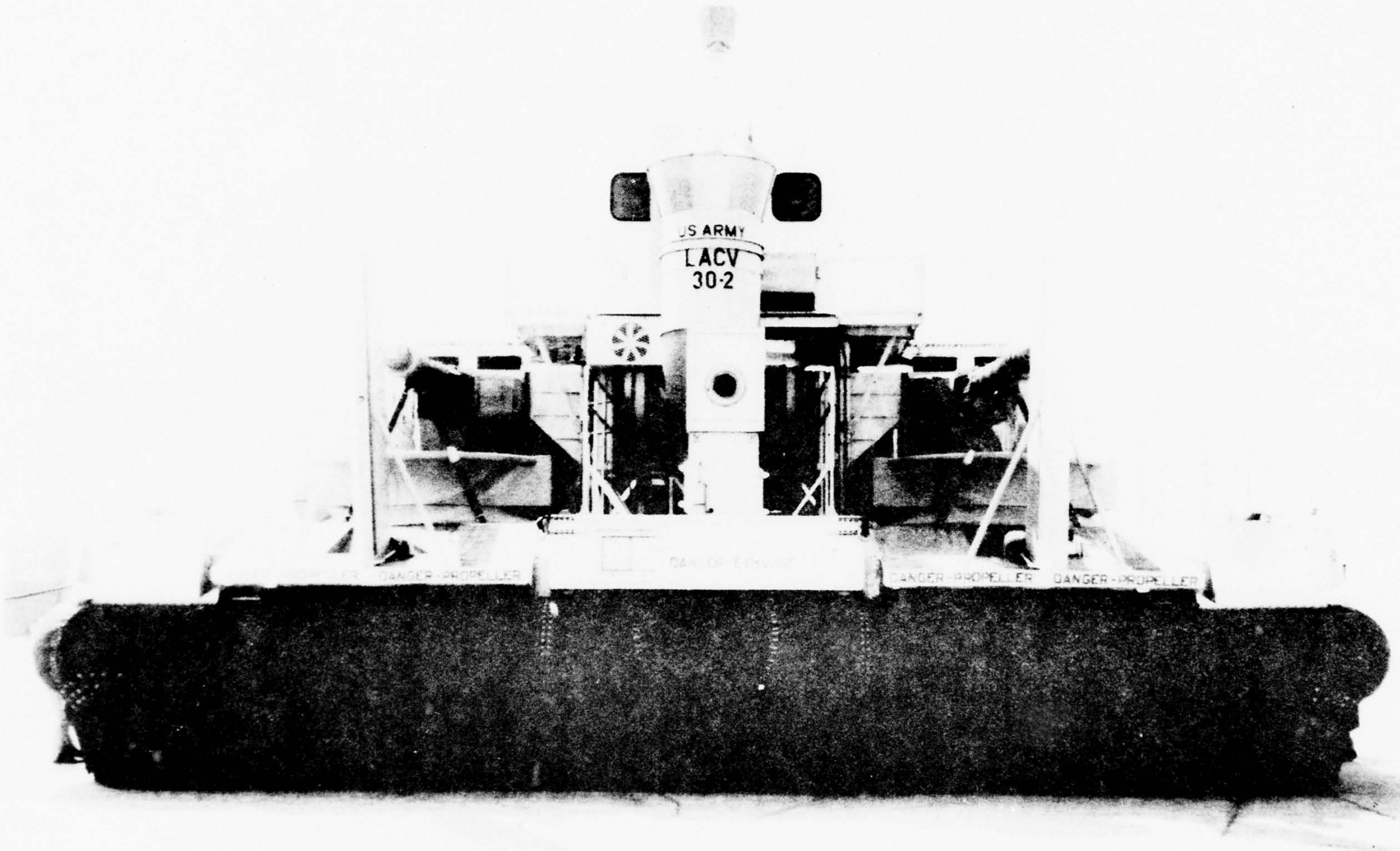



FIGURE 7. STERN VIEW OF LACV-30-2 VEHICLE SHOWING MODIFIED STERN SEAL, $W = 52,000$ LBS., $N_{H} = 90\%$

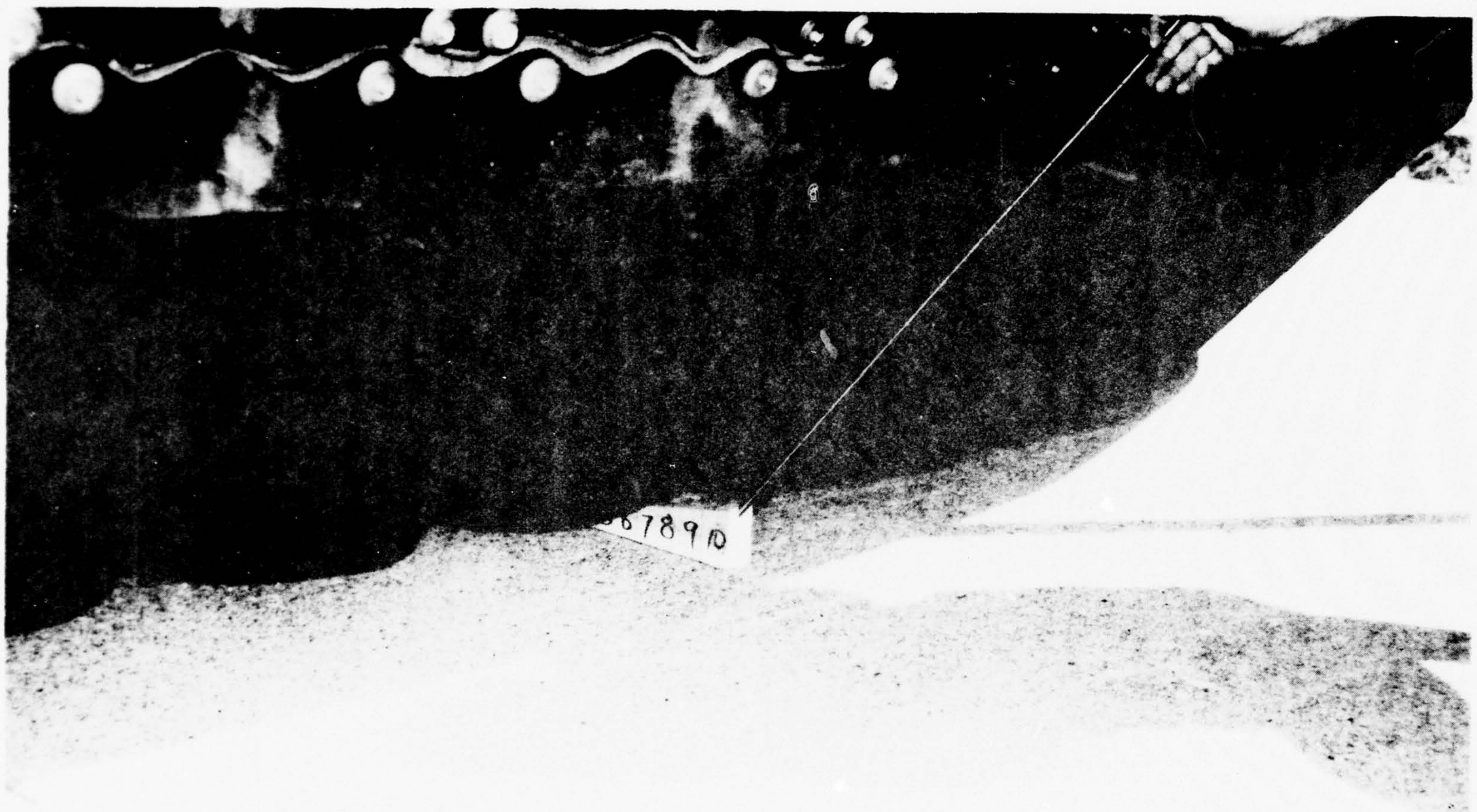



FIGURE 8. WEDGE USED TO MEASURE CUSHION AIR GAP

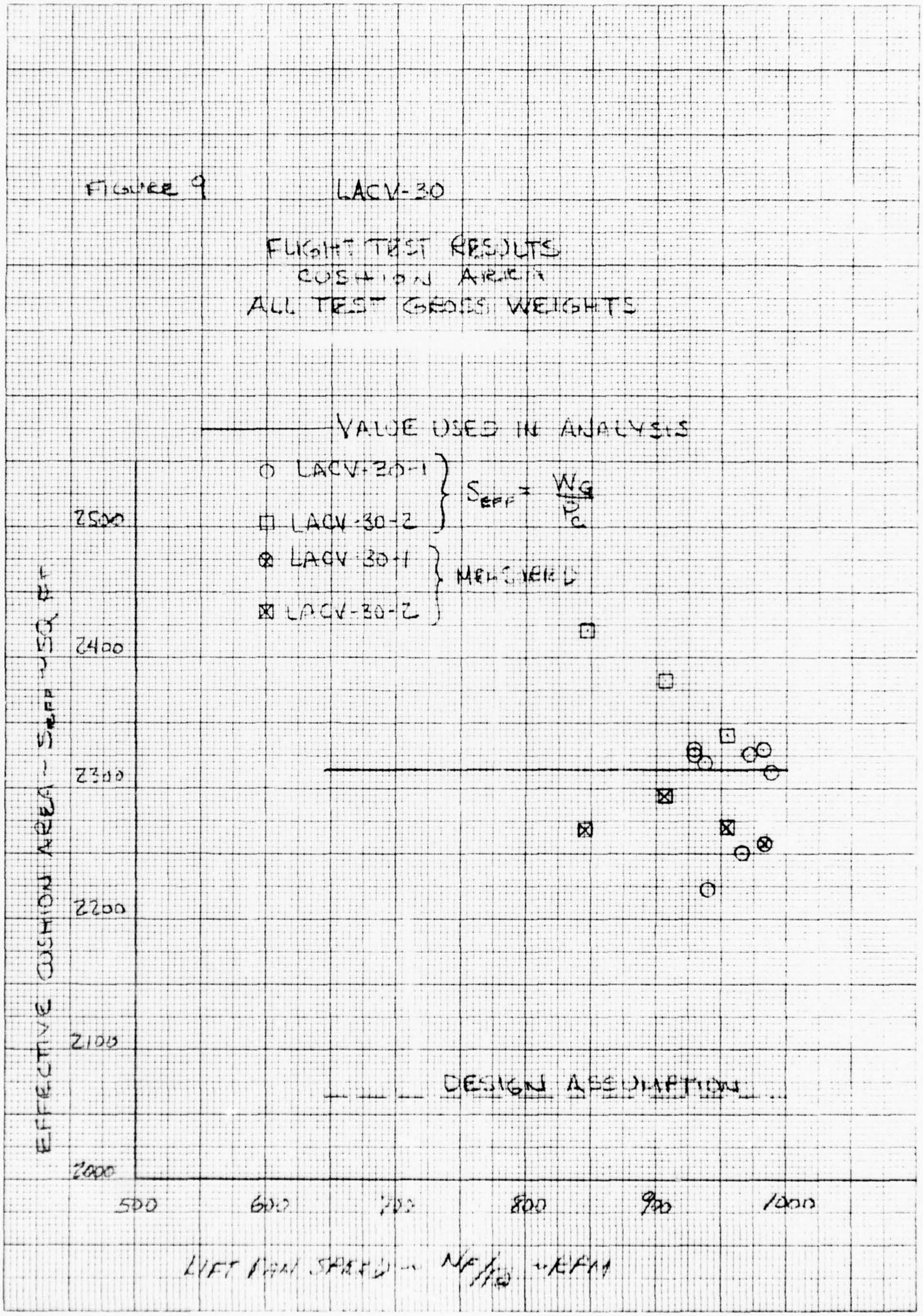
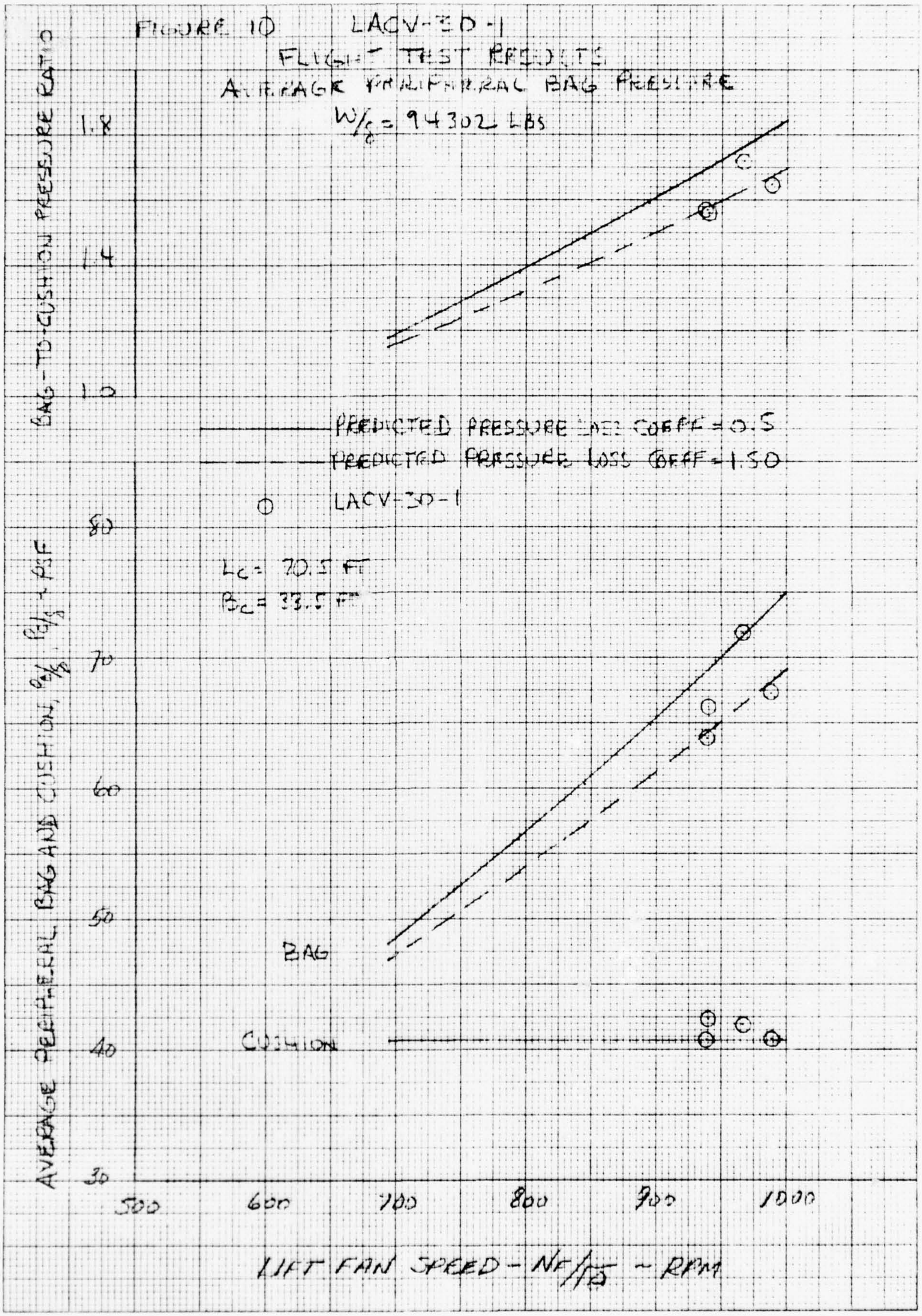
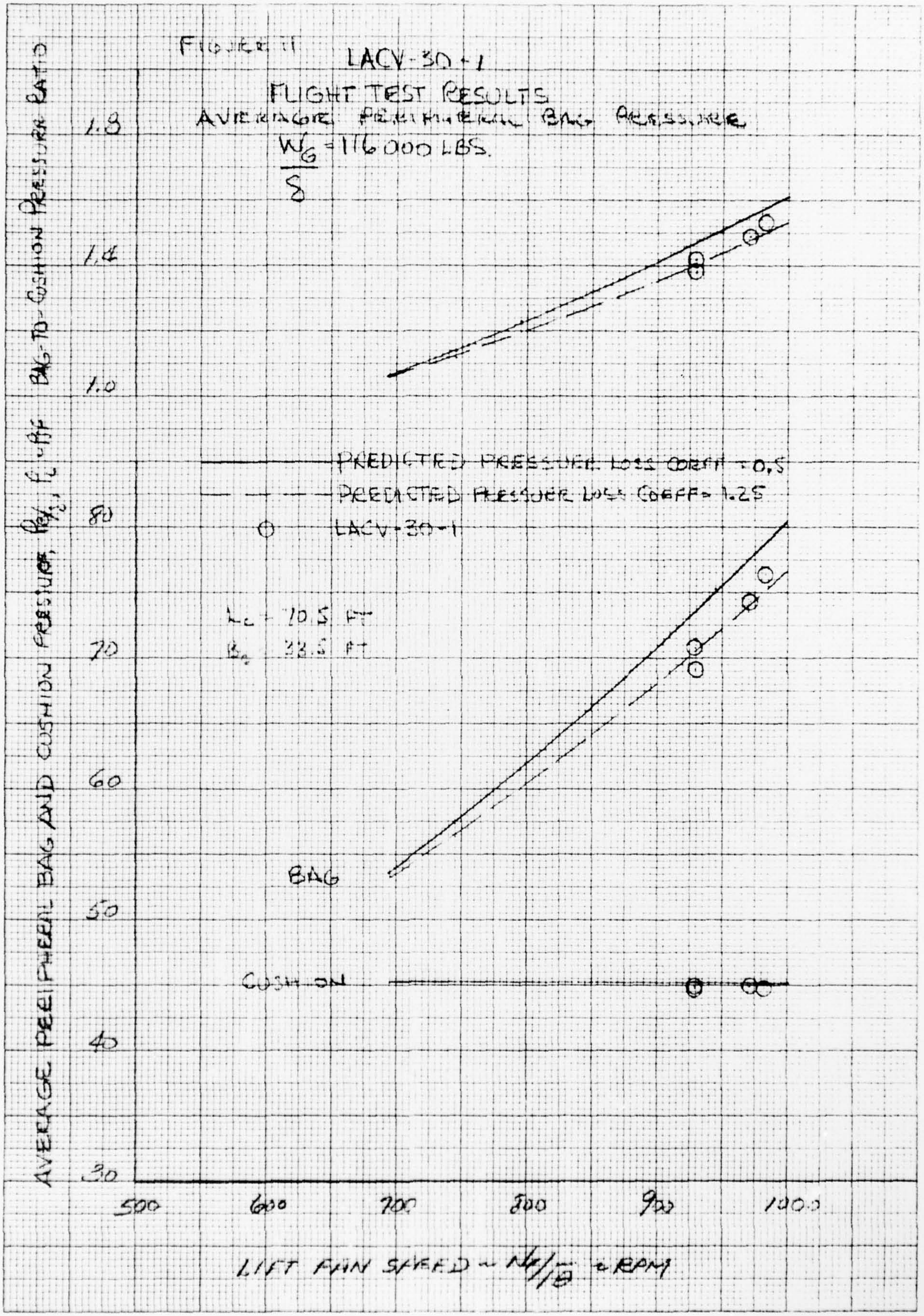


FIGURE 9
LACV-30
FLIGHT TEST RESULTS
CUSHION AREA
ALL TEST GROSS WEIGHTS
VALUE USED IN ANALYSIS
LACV-30-1
LACV-30-2
LACV-30-1
LACV-30-2
MEASURED
DESIGN ASSUMPTION
EFFECTIVE CUSHION AREA - SQ FT
2500
2400
2300
2200
2100
2000
500
600
800
900
1000




46 1323

K+E 10 X 10 TO 1/2 INCH 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.




K-E 10 X 10 TO ½ INCH 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.

46 1323

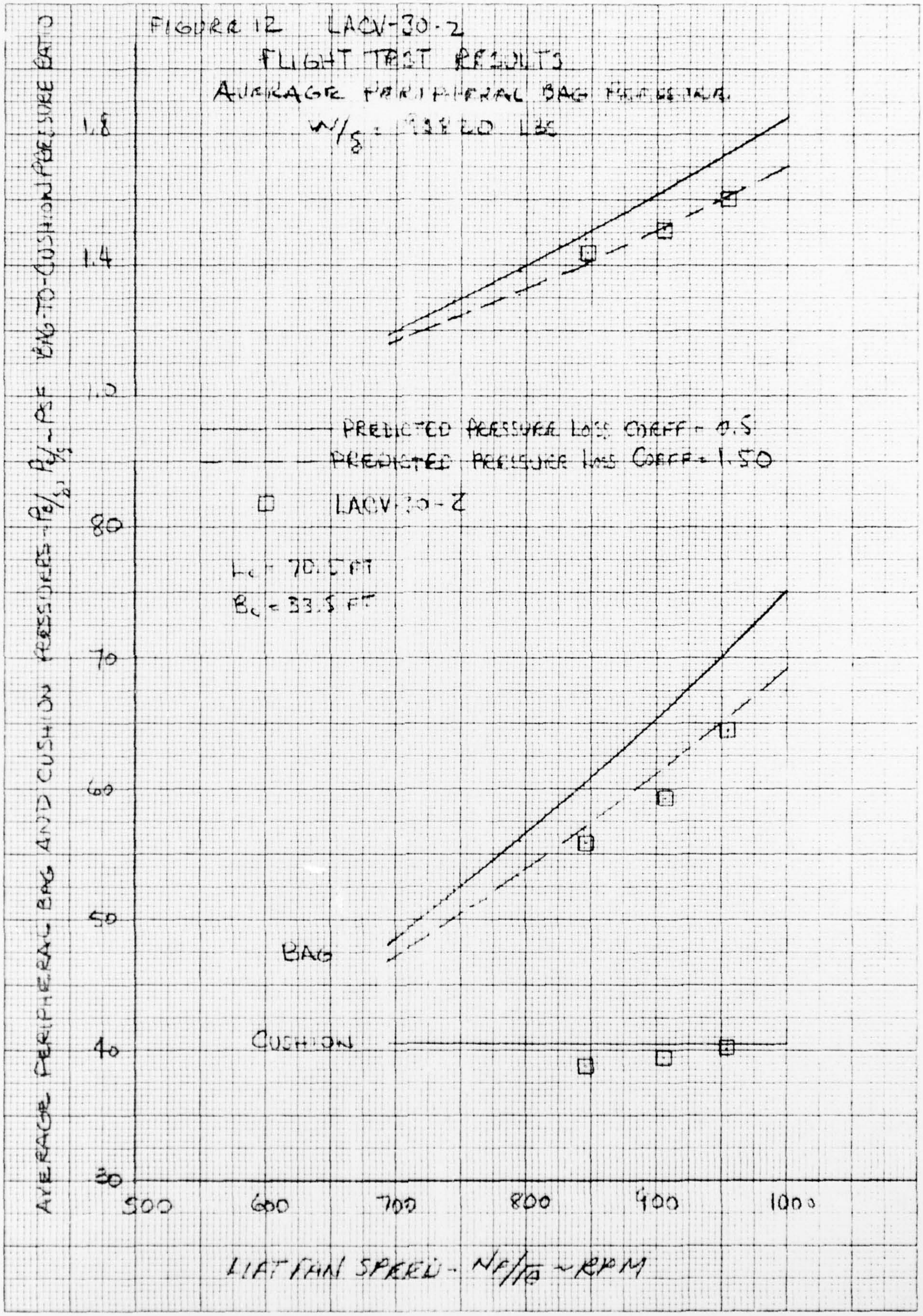


FIGURE 12 LACV-30-2
FLIGHT TEST RESULTS
AVERAGE PERIPHERAL BAG PRESSURE
PREDICTED PRESSURE LOSS COEFF = 0.5
PREDICTED PRESSURE LOSS COEFF = 1.50
LACV-30-2
BAG
CUSHION
1.8
1.4
1.0
80
70
60
50
40
30
500
600
700
800
900
1000
LIFT FAN SPEED - RPM
AVERAGE PERIPHERAL BAG AND CUSHION PRESSURES

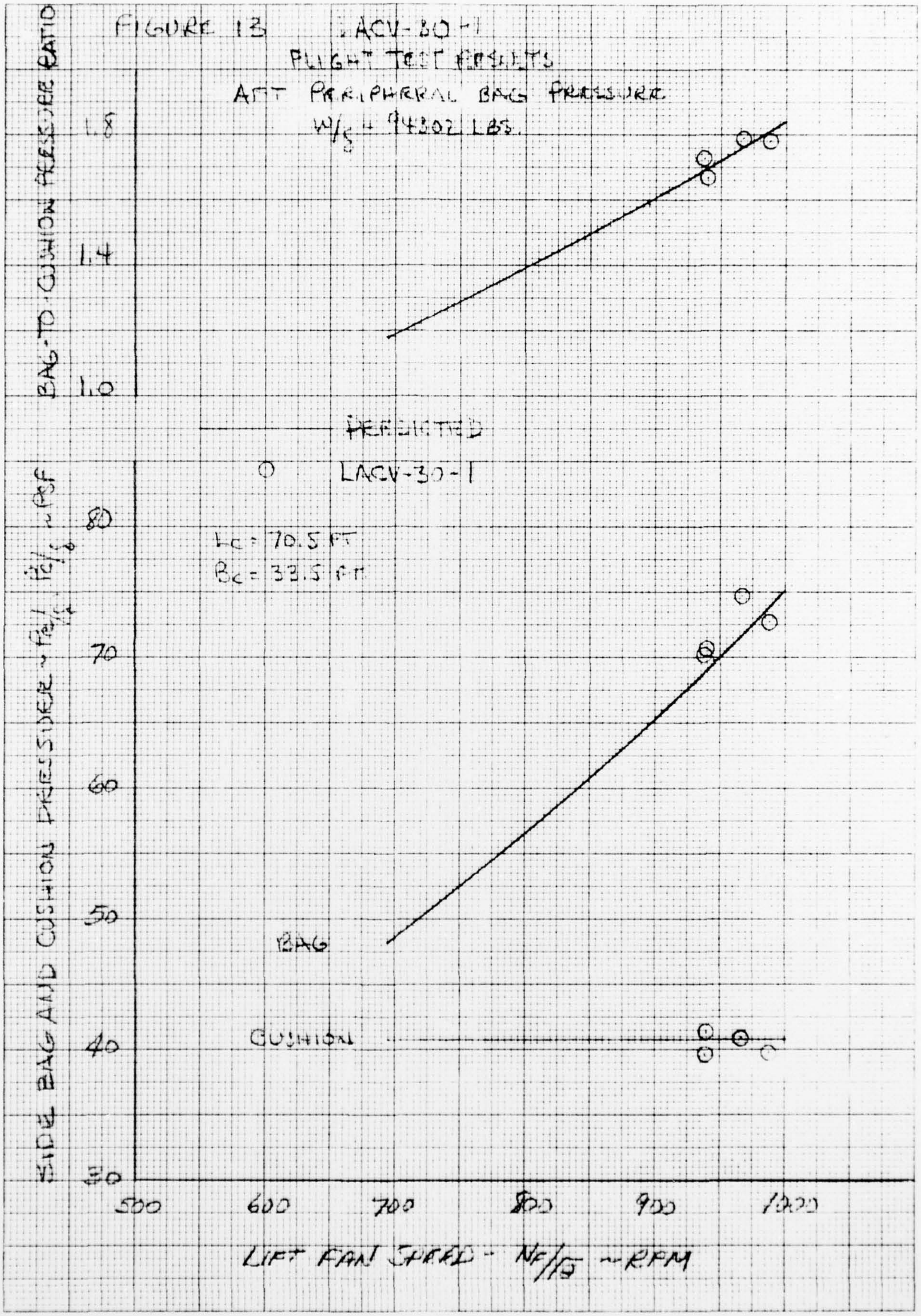


FIGURE 13 LACV-30-1
FLIGHT TEST RESULTS
AFT PERIPHERAL BAG PRESSURE
W/S = 94302 LBS.
BAG-TO-CUSHION PRESSURE RATIO
1.8
1.4
1.0
PREDICTED
LACV-30-1
Lc = 70.5 FT
Bc = 33.5 FT
SIDE BAG AND CUSHION PRESSURE ~ Pc/δ, Pb/δ ~ PSF
80
70
60
50
40
30
BAG
CUSHION
500
600
700
800
900
1000
LIFT FAN SPEED ~ NF/√θ ~ RPM

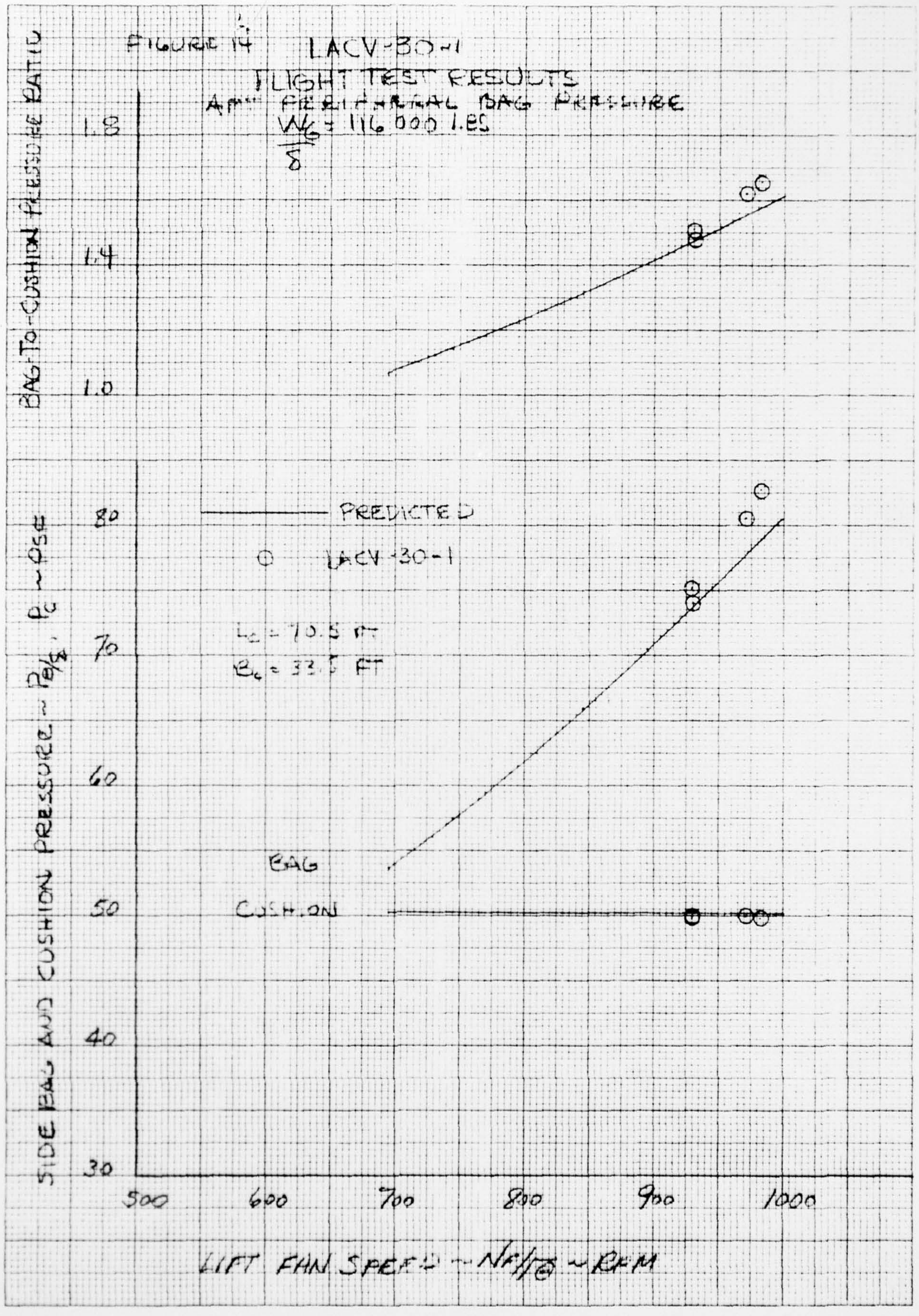


FIGURE 14 LACV-30-1
FLIGHT TEST RESULTS
PERIPHERAL BAG PRESSURE
BAG-TO-CUSHION PRESSURE RATIO
SIDE BAG AND CUSHION PRESSURE
PREDICTED
LACV-30-1
BAG
CUSHION
LIFT FAN SPEED ~ RPM
500
600
700
800
900
1000
1.0
1.4
1.8
30
40
50
60
70
80

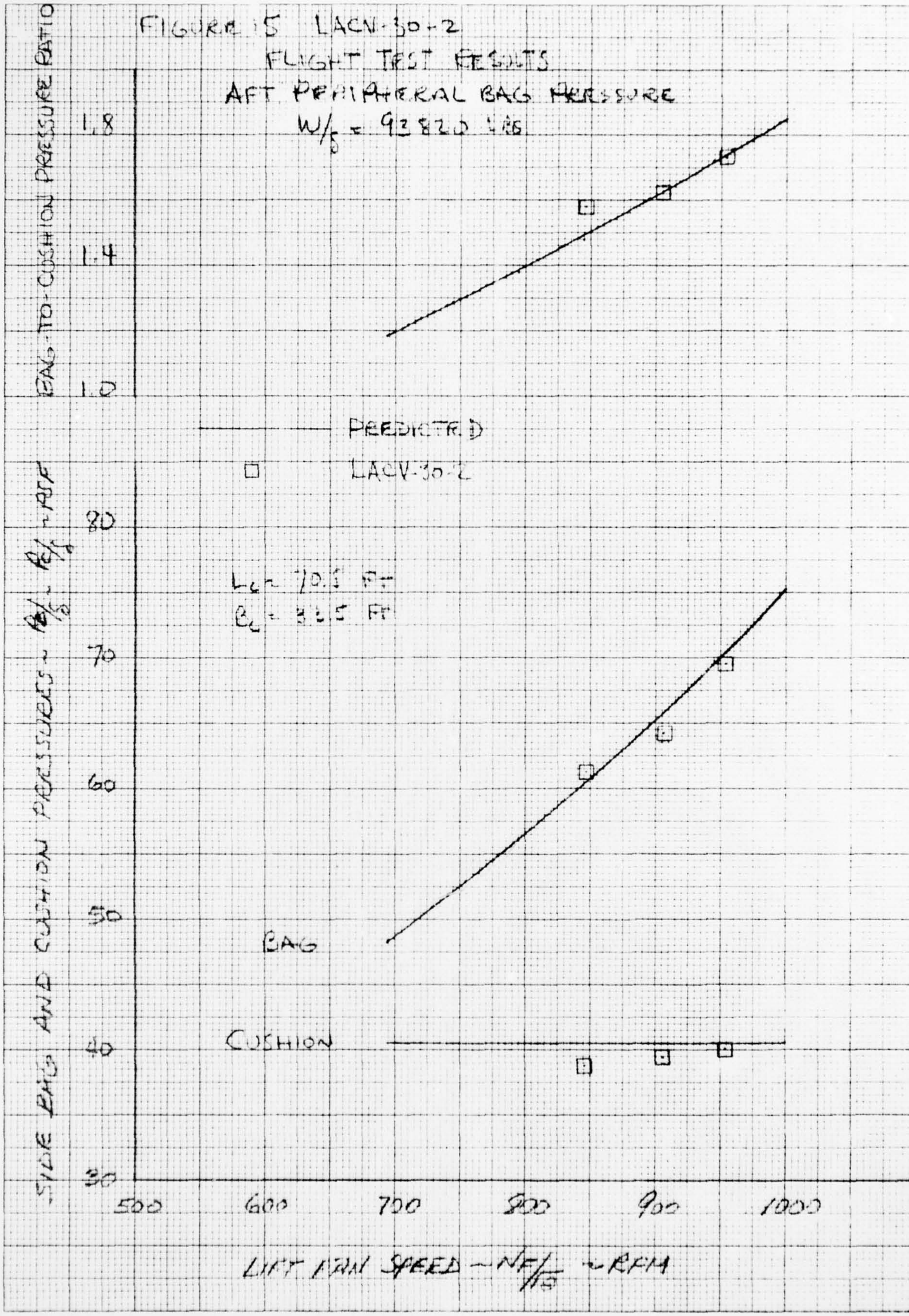


FIGURE 5 LACV-30-2
FLIGHT TEST RESULTS
AFT PERIPHERAL BAG PRESSURE
W/δ = 93820 lbs
BAG-TO-CUSHION PRESSURE RATIO
1.8
1.4
1.0
PREDICTED
LACV-30-2
SIDE BAG AND CUSHION PRESSURES ~ PB/δ, PC/δ ~ PSF
80
70
60
50
40
30
BAG
CUSHION
500
600
700
800
900
1000
LIFT FAN SPEED ~ NF/√θ ~ RPM

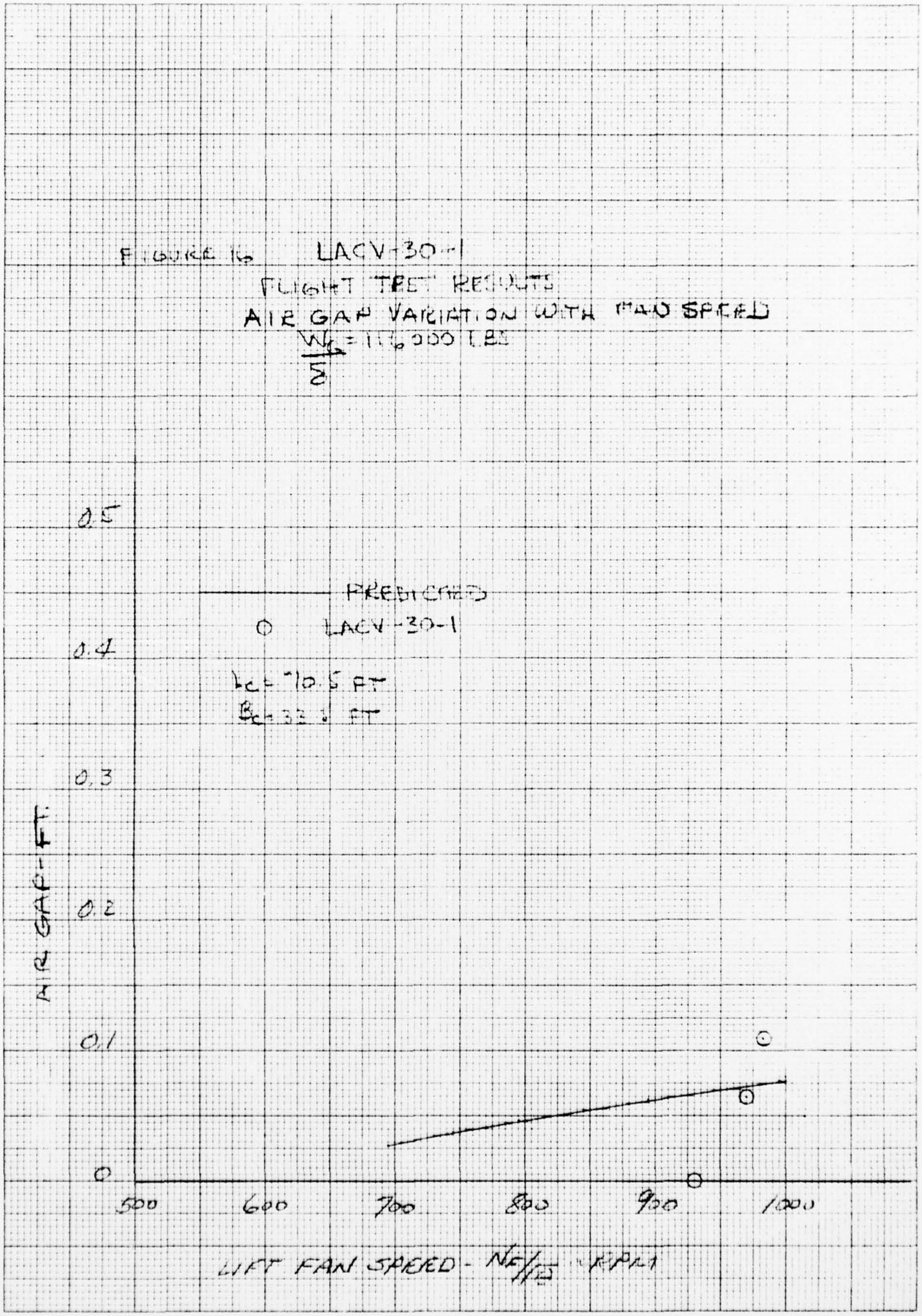


FIGURE 16 LACV-30-1
FLIGHT TEST RESULTS
AIR GAP VARIATION WITH FAN SPEED
PREDICTED
LACV-30-1
0.5
0.4
0.3
0.2
0.1
0
500
600
700
800
900
1000
AIR GAP - FT.
LIFT FAN SPEED - RPM

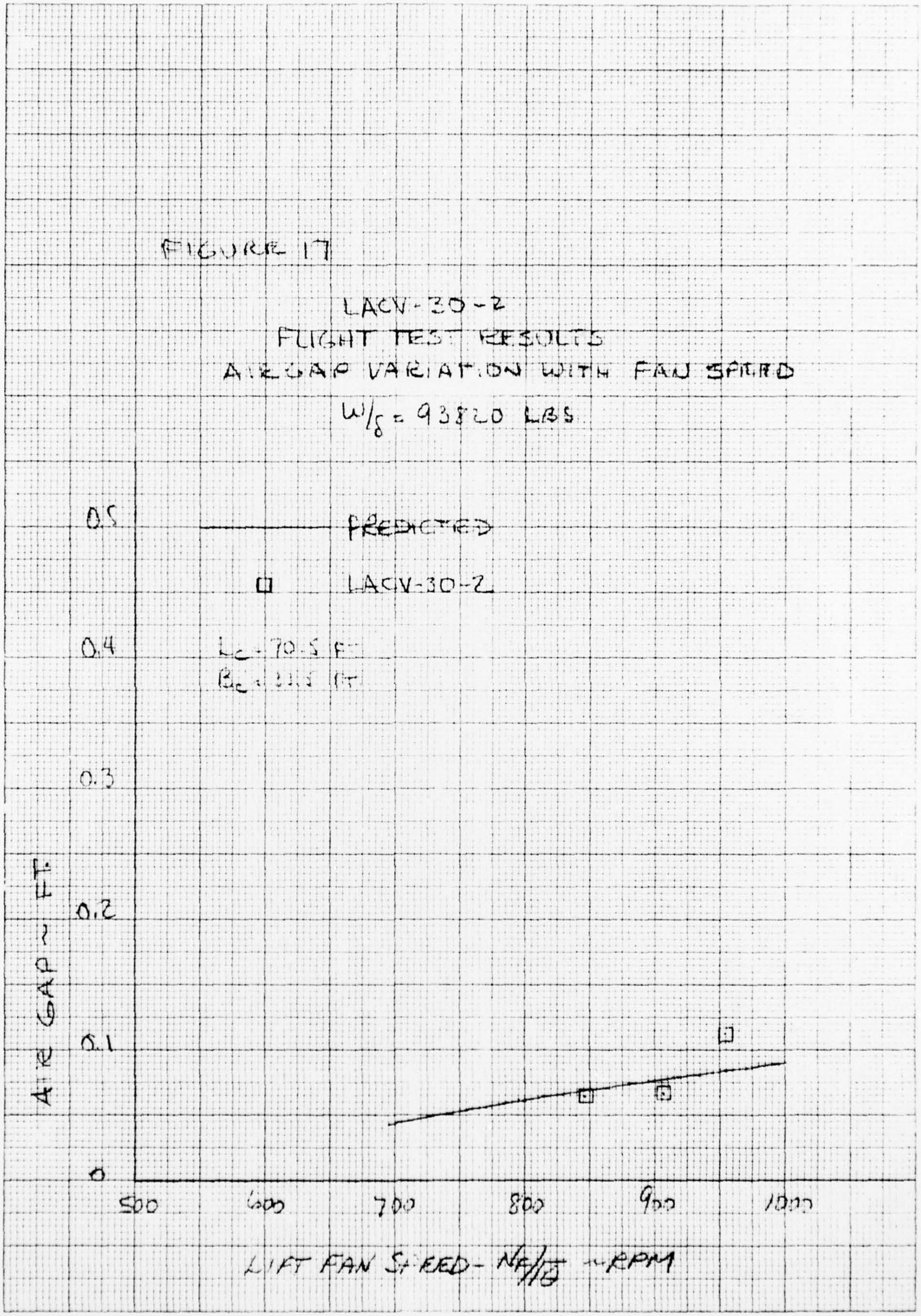


FIGURE 17
LACV-30-2
FLIGHT TEST RESULTS
AIR GAP VARIATION WITH FAN SPEED
W/δ = 93820 LBS
0.5
PREDICTED
LACV-30-2
0.4
0.3
0.2
0.1
0
AIR GAP ~ FT.
500
600
700
800
900
1000
LIFT FAN SPEED - NF/√θ ~RPM

FIGURE 18

LACV-30-1

FLIGHT TEST RESULTS

HEAVE HEIGHT VARIATION WITH FAN SPEED

$\frac{W_G}{\delta}$ = 94302 LBS

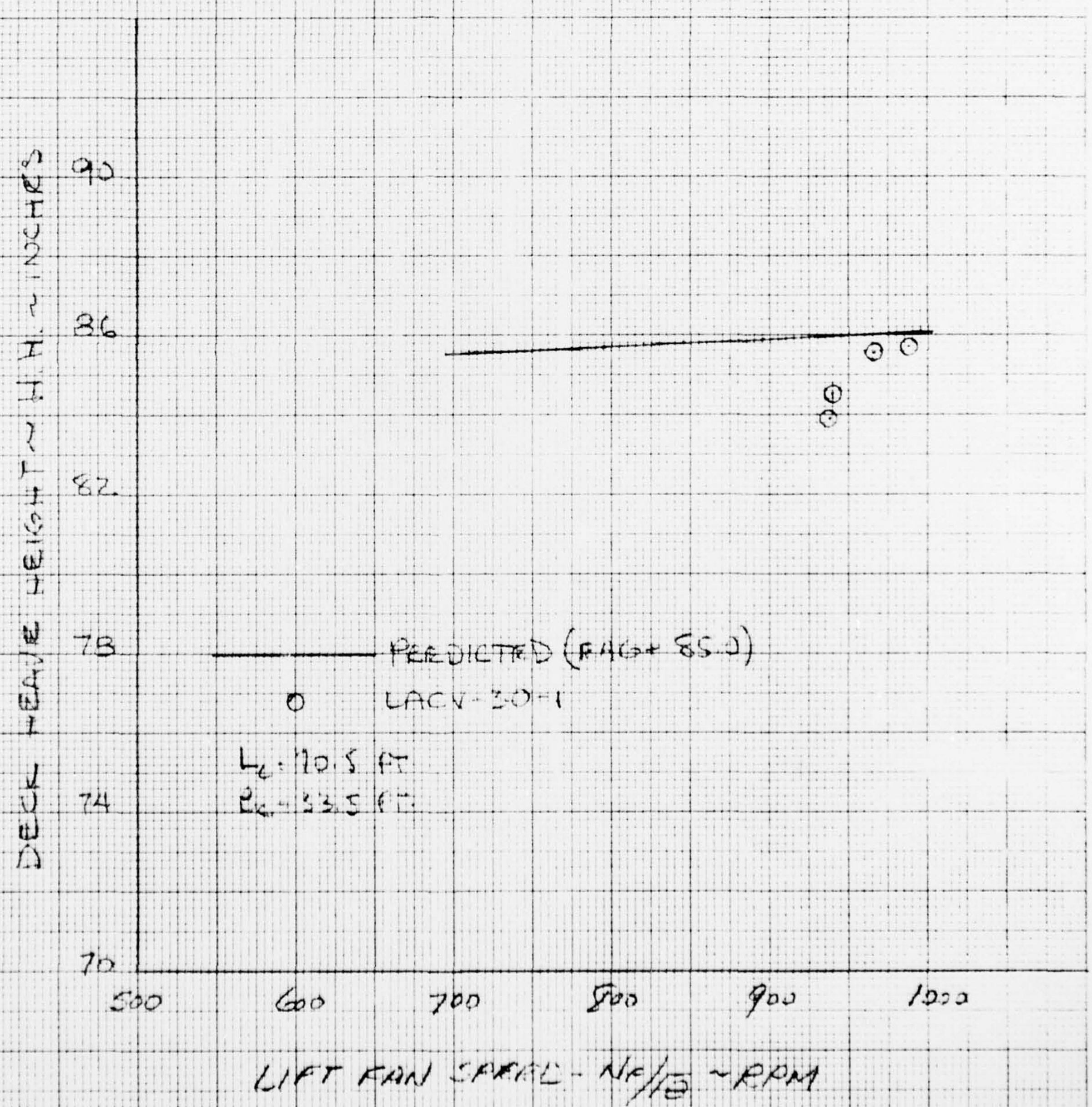
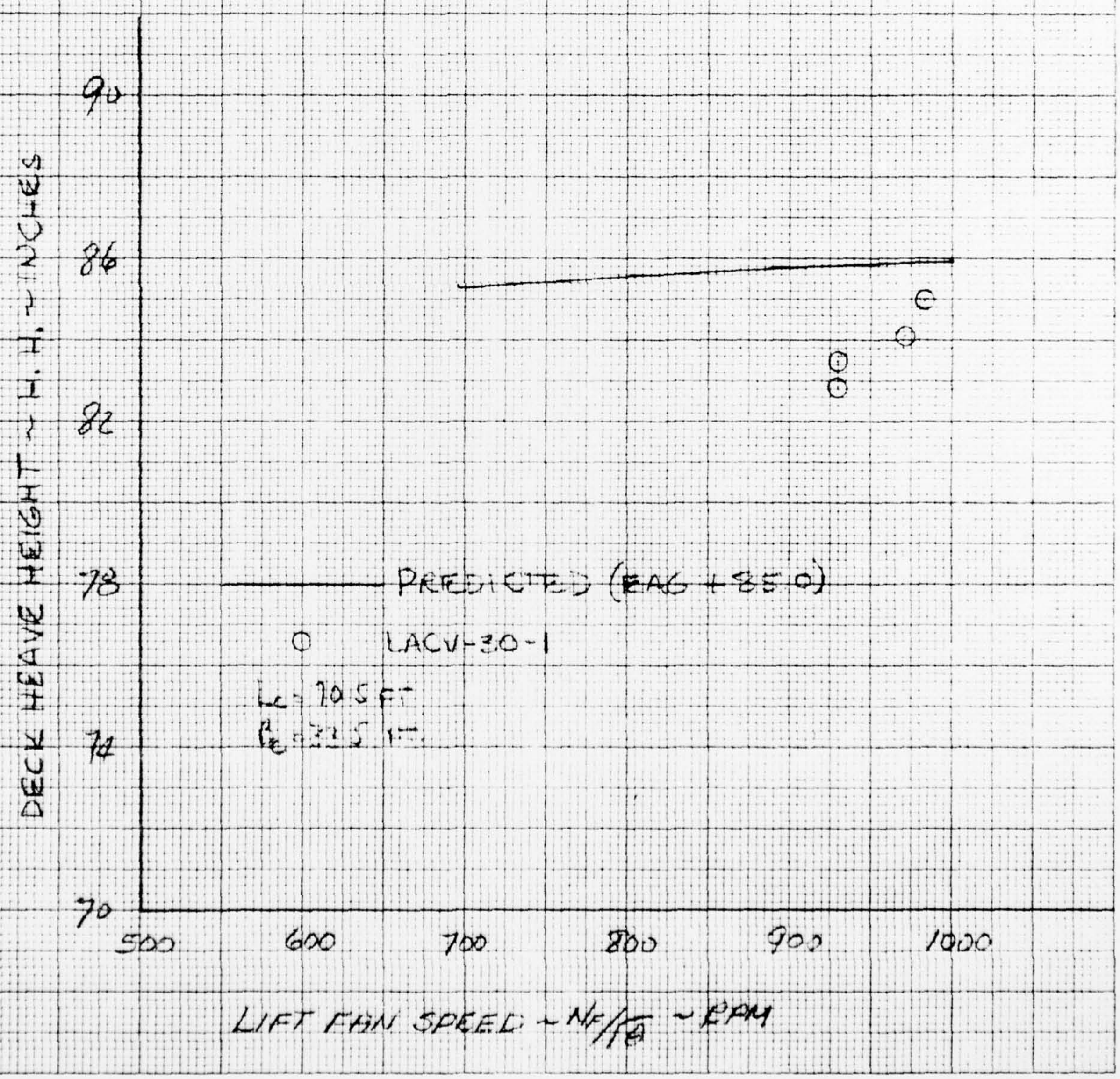


FIGURE 19 LACV-30-1

FLIGHT TEST RESULTS

HEAVE HEIGHT VARIATION WITH FAN SPEED

$\frac{W_G}{\delta}$ = 116000 LBS.



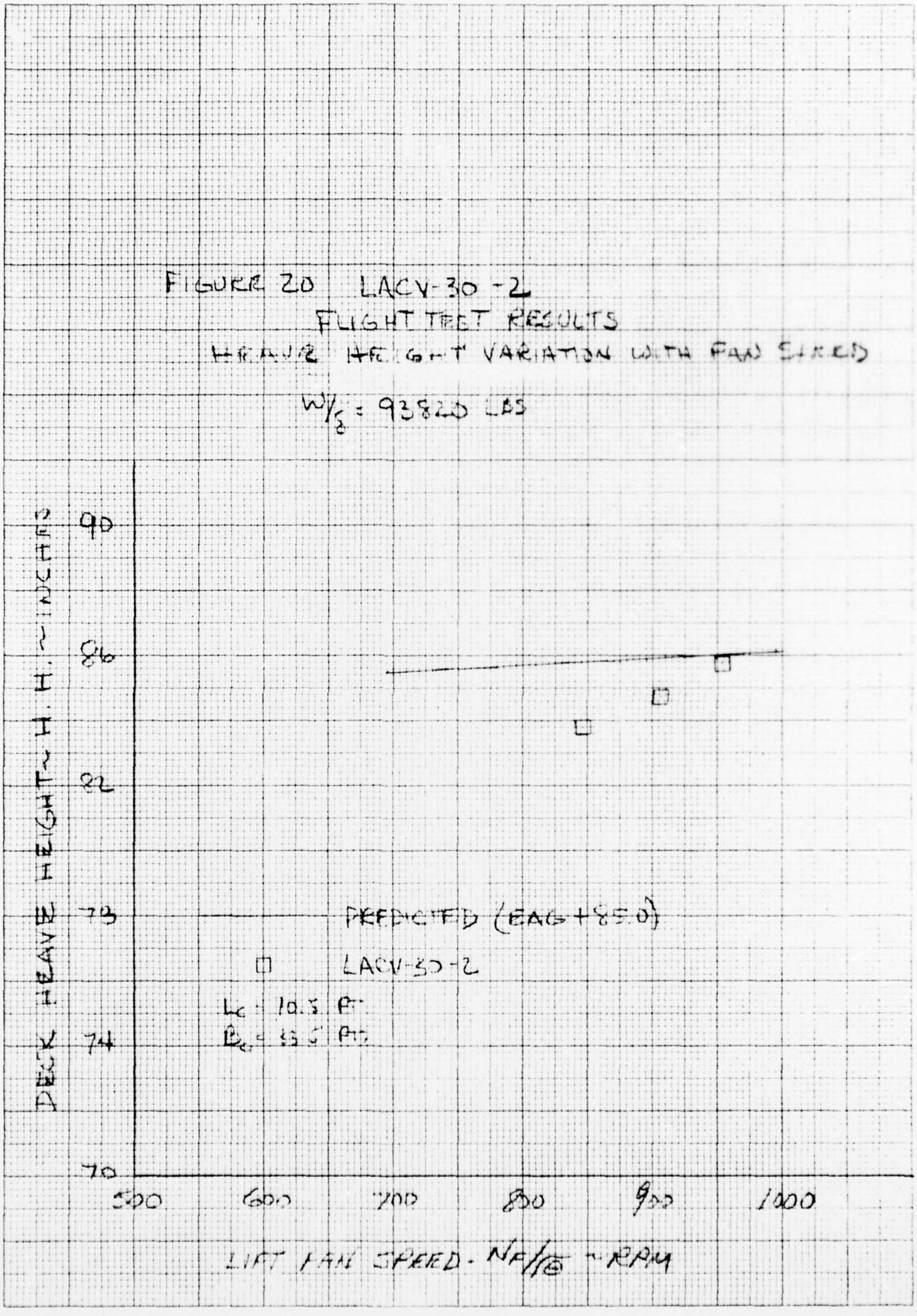


FIGURE 20 LACV-30-2
FLIGHT TEST RESULTS
HEAVE HEIGHT VARIATION WITH FAN SPEED
DECK HEAVE HEIGHT ~ H.H. ~ INCHES
90
86
82
78
74
70
500
600
700
800
900
1000
PREDICTED
LACV-30-2
LIFT FAN SPEED

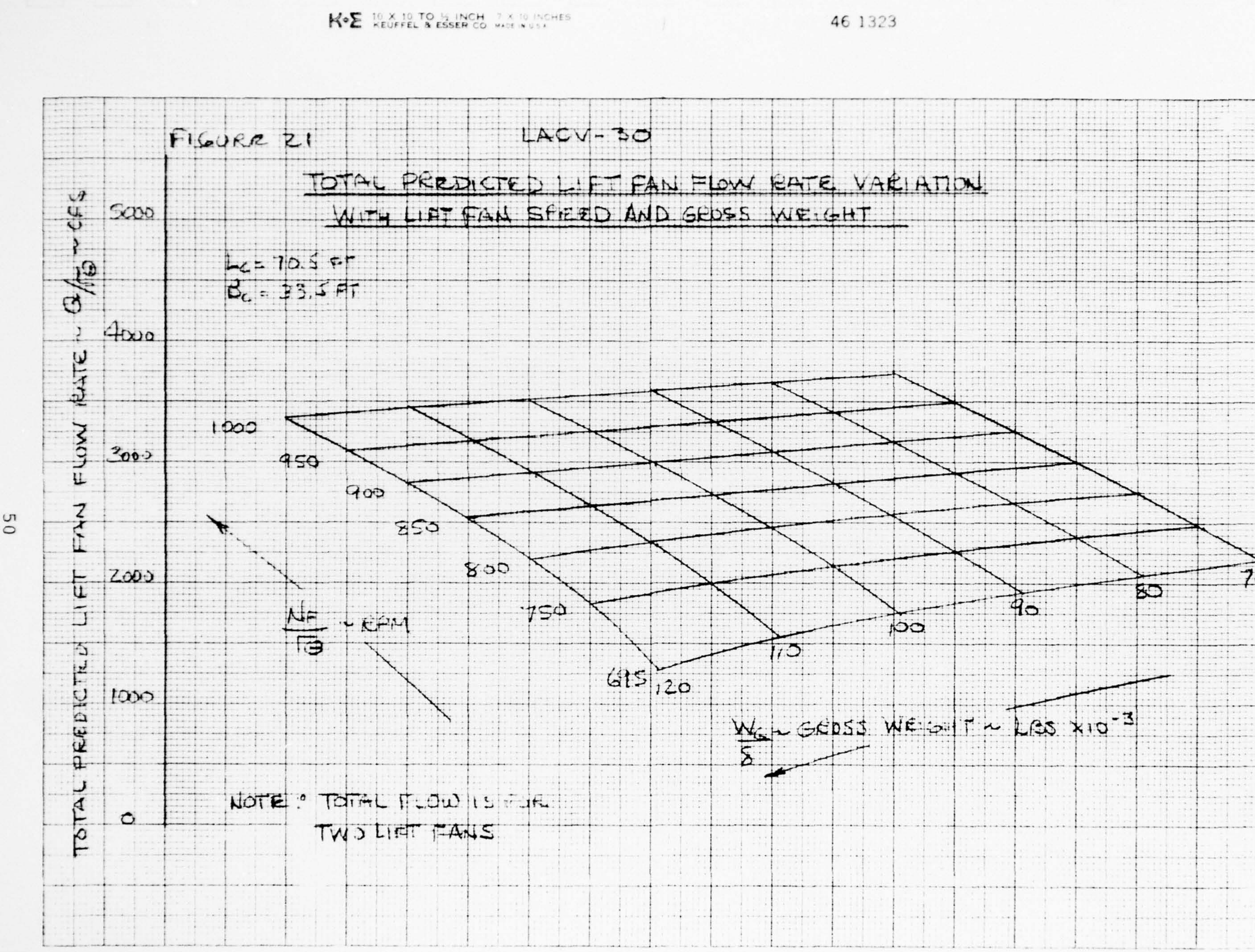
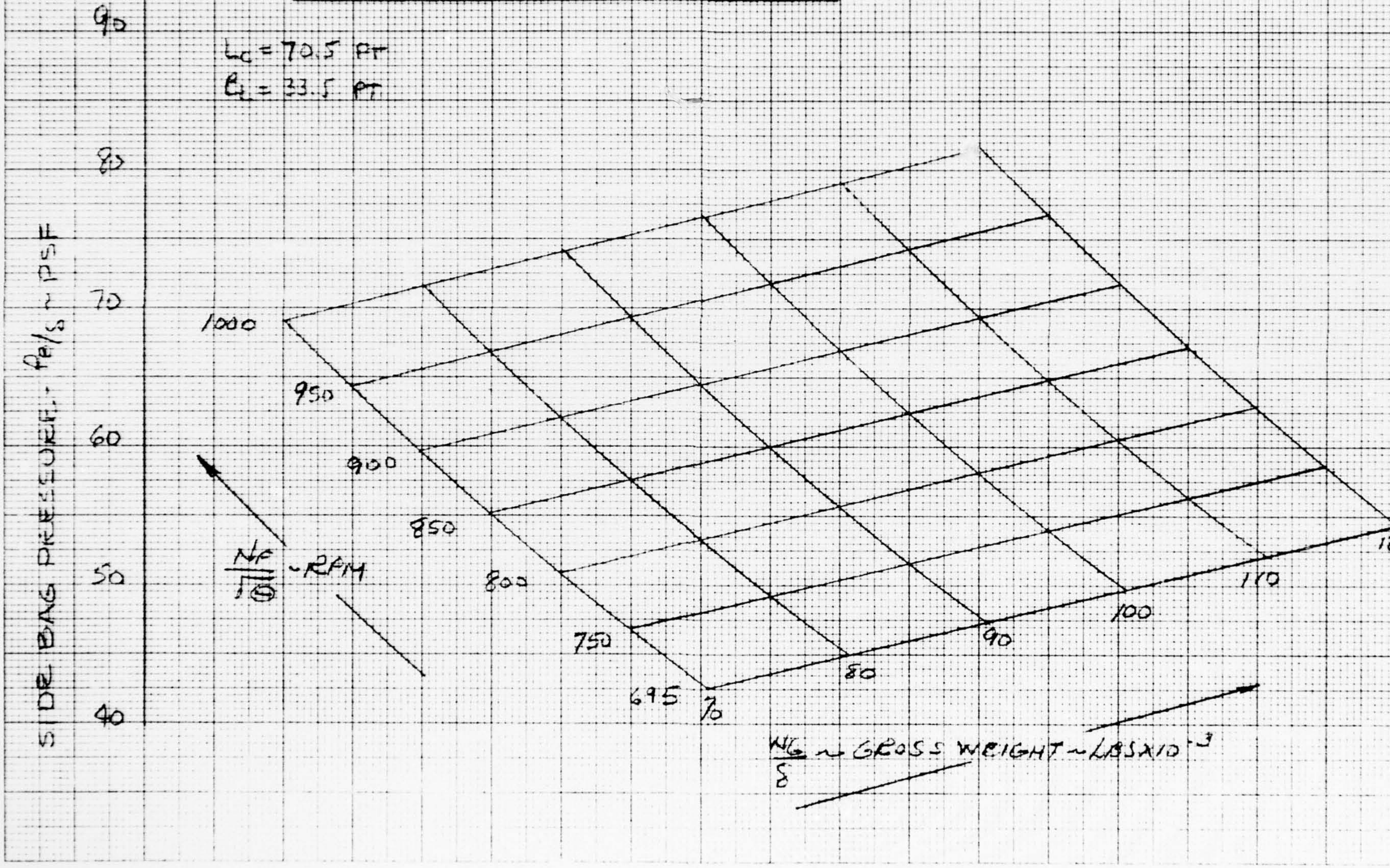

K•E 10 X 10 TO ½ INCH 7 X 10 INCHES KEUFFEL & ESSER CO. MADE IN U.S.A.
46 1323
FIGURE 21
LACV-30
TOTAL PREDICTED LIFT FAN FLOW RATE VARIATION
WITH LIFT FAN SPEED AND GROSS WEIGHT
$L_c$ = 70.5 FT
$B_c$ = 33.5 FT
TOTAL PREDICTED LIFT FAN FLOW RATE ~ $Q/\sqrt{\theta}$ ~ CFS
5000
4000
3000
2000
1000
0
1000
950
900
850
800
750
615
$N_F/\sqrt{\theta}$ ~ RPM
120
110
100
90
80
70
$W_G/\delta$ ~ GROSS WEIGHT ~ LBS $\times 10^{-3}$
NOTE: TOTAL FLOW IS FOR
TWO LIFT FANS

FIGURE 22

LACV-30

PREDICTED SIDE BAG PRESSURE VARIATION WITH
LIFT FAN SPEED AND GROSS WEIGHT



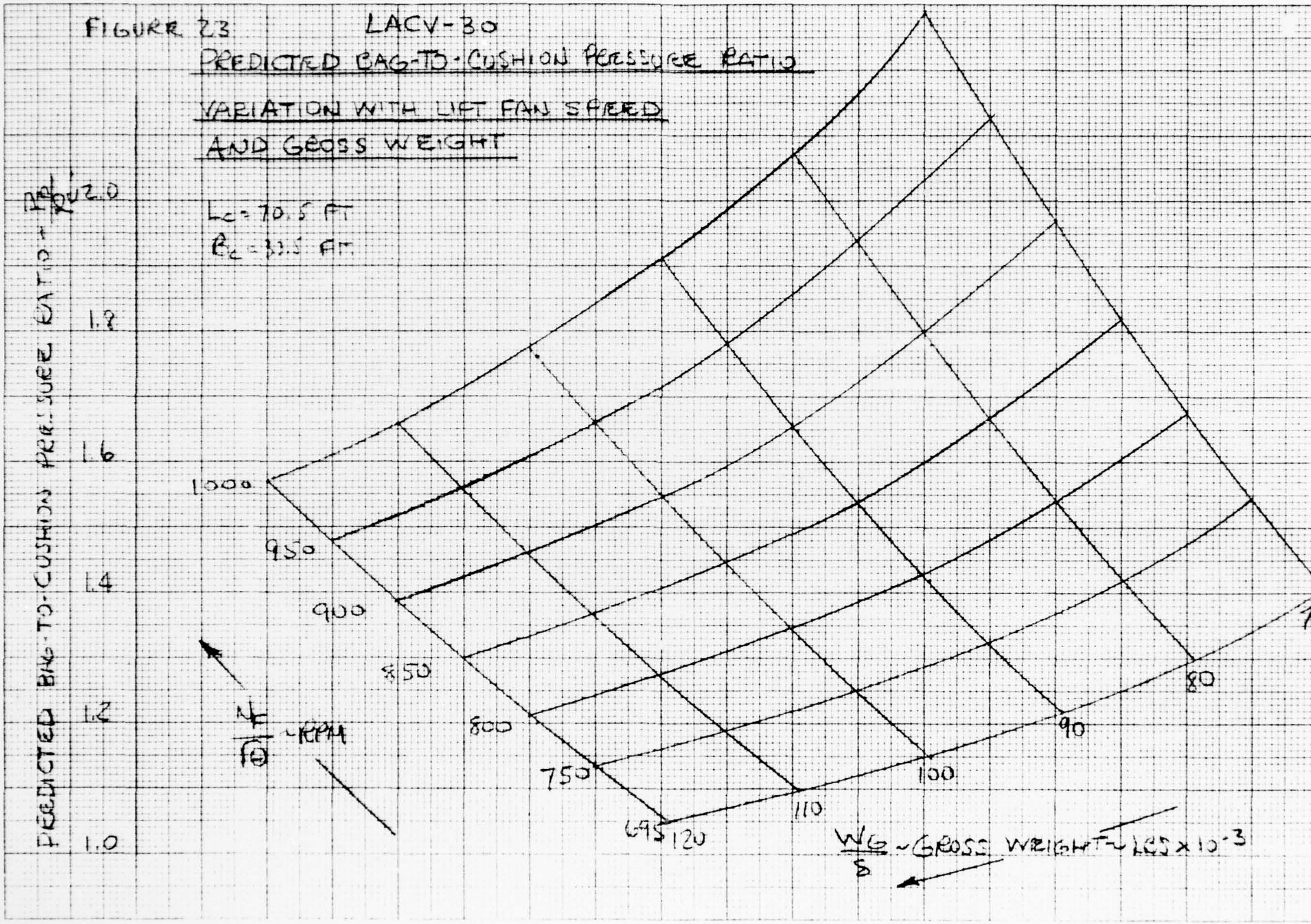
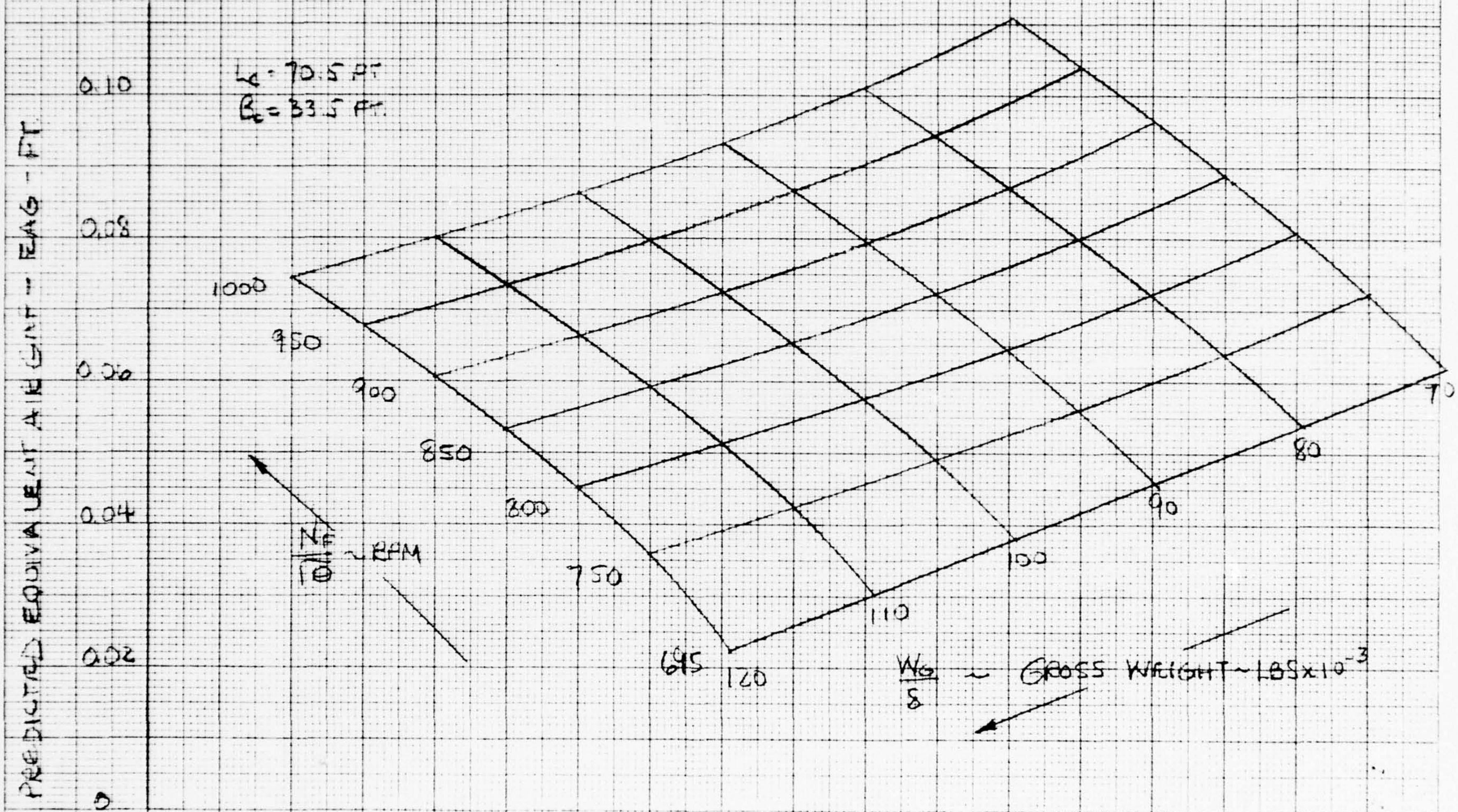



FIGURE 23 PREDICTED BAG-TO-CUSHION PRESSURE RATIO VARIATION WITH LIFT FAN SPEED AND GROSS WEIGHT

FIGURE 24 LACV-30

PREDICTED EQUIVALENT AIR GAP (EAG) VARIATION WITH LIFT FAN SPEED AND GROSS WEIGHT



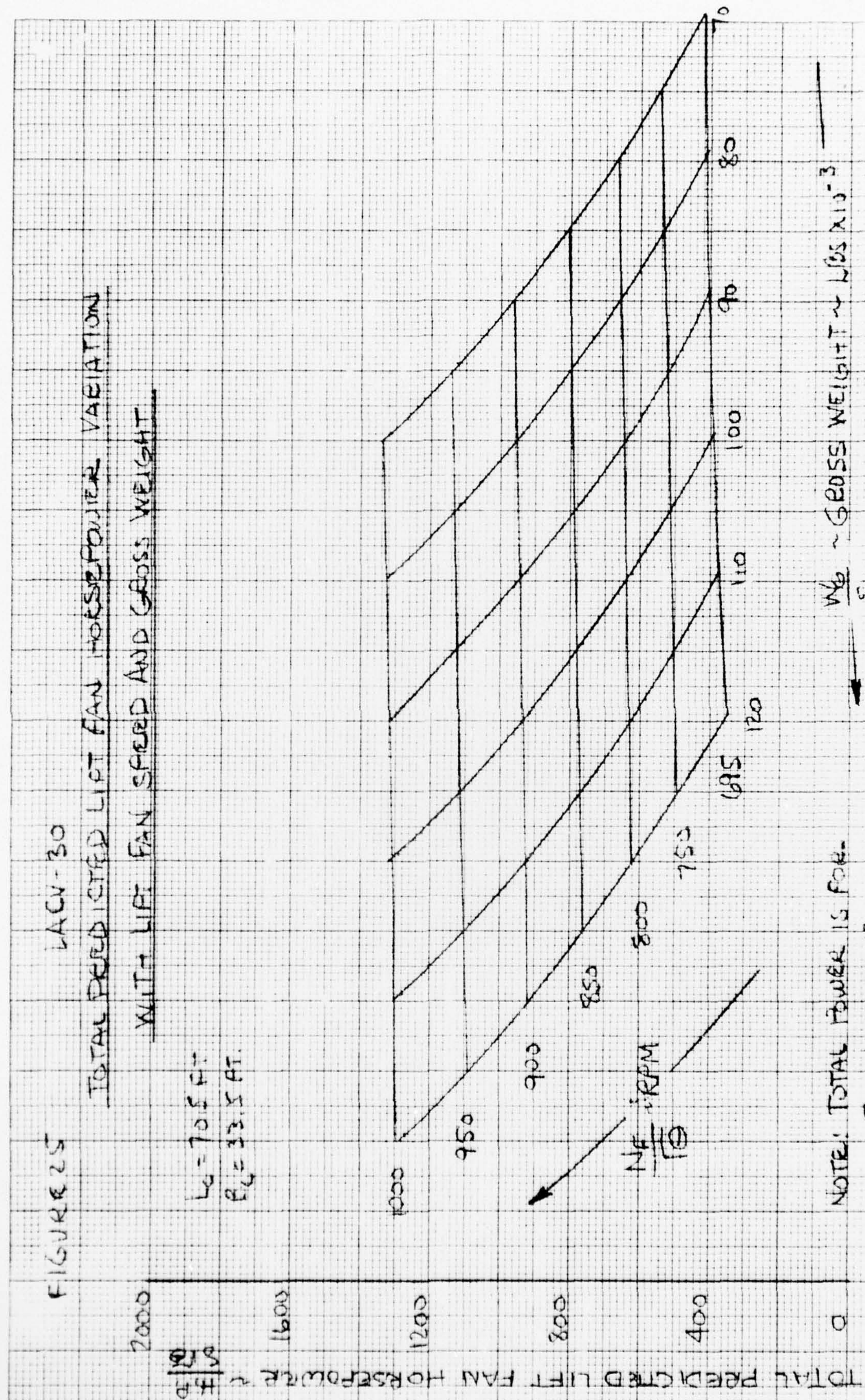


FIGURE 25
LACV-30
TOTAL PREDICTED LIFT FAN HORSEPOWER VARIATION
WITH LIFT FAN SPEED AND GROSS WEIGHT
$L_c$ = 70.5 FT.
$B_c$ = 33.5 FT.
$\frac{N_F}{\sqrt{\theta}}$ ~ RPM
1000
950
900
850
800
750
695
TOTAL PREDICTED LIFT FAN HORSEPOWER ~ $\frac{HP}{\delta\sqrt{\theta}}$
2000
1600
1200
800
400
0
$\frac{W_G}{\delta}$ ~ GROSS WEIGHT ~ LBS x10$^{-3}$
70
80
90
100
110
120
NOTE: TOTAL POWER IS FOR TWO LIFT FANS.